VOLUME 29 / NUMBER 24
DECEMBER 23, 1991
ACC. NOS. N91-32032 TO N91-33053

STAR
AN ABSTRACT JOURNAL

# Scientific and Technical Aerospace Reports

PRODUCED BY THE
SCIENTIFIC AND TECHNICAL
INFORMATION
PROGRAM

NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

***Scientific and Technical Aerospace Reports* (*STAR*)** is an abstract journal that provides comprehensive coverage of worldwide aerospace-related reports. It is a major product of the International Aerospace Database managed by the NASA Scientific and Technical Information (STI) Program. The coverage includes reports on aeronautics, space, and supporting disciplines. *STAR* lists current, publicly available reports entered into the NASA STI Database during the 2-week period preceding publication. A typical citation and abstract appear on page viii. They explain how to read the items that are announced in this journal.

NASA sponsors a companion journal, *International Aerospace Abstracts* (*IAA*), that lists abstracts of the open literature on aerospace subjects available worldwide. *IAA* is available through the American Institute of Aeronautics and Astronautics.

Entries found in *STAR* and *IAA* are available through NASA's online service, RECON, as the International Aerospace Database and through DIALOG as the Aerospace Database.

Information on aerospace and related subjects is gathered by the NASA STI Program through national and international agreements and exchanges and is made available to the NASA community as well as to the public in many forms through various outlets. The section on NASA STI Program Products and Services contains additional information.

**US ISSN 0036-8741**

*Volume 29 Number 24 / DECEMBER 23, 1991*

# TABLE OF CONTENTS

## AERONAUTICS For related information see also *Astronautics.*

**01 AERONAUTICS (GENERAL)** ..... **3943**

**02 AERODYNAMICS** ..... **3949**
Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information see also *34 Fluid Mechanics and Heat Transfer.*

**03 AIR TRANSPORTATION AND SAFETY** ..... **3952**
Includes passenger and cargo air transport operations; and aircraft accidents. For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

**04 AIRCRAFT COMMUNICATIONS AND NAVIGATION** ..... **3954**
Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

**05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE** ..... **3960**
Includes aircraft simulation technology. For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

**06 AIRCRAFT INSTRUMENTATION** ..... **3961**
Includes cockpit and cabin display devices; and flight instruments. For related information see also *19 Space craft Instrumentation* and *35 Instrumentation and Photography.*

**07 AIRCRAFT PROPULSION AND POWER** ..... **3961**
Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

**08 AIRCRAFT STABILITY AND CONTROL** ..... **3962**
Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information see also *05 Aircraft Design, Testing and Performance.*

**09 RESEARCH AND SUPPORT FACILITIES (AIR)** ..... **3963**
Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information see also *14 Ground Support Systems and Facilities (Space).*

## ASTRONAUTICS For related information see also *Aeronautics.*

**12 ASTRONAUTICS (GENERAL)** ..... **3964**
For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

**13 ASTRODYNAMICS** ..... **3965**
Includes powered and free-flight trajectories; and orbital and launching dynamics.

**14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)** ..... **N.A.**
Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators. For related information see also *09 Research and Support Facilities (Air).*

**15 LAUNCH VEHICLES AND SPACE VEHICLES** ..... **3965**
Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information see also *20 Spacecraft Propulsion and Power.*

**16 SPACE TRANSPORTATION** ..... **N.A.**
Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

**17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING** . **N.A.**
Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout. For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

**N.A.—no abstracts were assigned to this category for this issue.**

**18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE** ..... **3966**
Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

**19 SPACECRAFT INSTRUMENTATION** ..... **N.A.**
For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

**20 SPACECRAFT PROPULSION AND POWER** ..... **3966**
Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

## CHEMISTRY AND MATERIALS

**23 CHEMISTRY AND MATERIALS (GENERAL)** ..... **N.A.**

**24 COMPOSITE MATERIALS** ..... **3969**
Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see *27 Nonmetallic Materials.*

**25 INORGANIC AND PHYSICAL CHEMISTRY** ..... **3972**
Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also *77 Thermodynamics and Statistical Physics.*

**26 METALLIC MATERIALS** ..... **3974**
Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

**27 NONMETALLIC MATERIALS** ..... **3978**
Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials.*

**28 PROPELLANTS AND FUELS** ..... **3980**
Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

**29 MATERIALS PROCESSING** ..... **3981**
Includes space-based development of products and processes for commercial application. For biological materials see *55 Space Biology.*

## ENGINEERING For related information see also *Physics.*

**31 ENGINEERING (GENERAL)** ..... **3981**
Includes vacuum technology; control engineering; disp'ay engineering; cryogenics; and fire prevention.

**32 COMMUNICATIONS AND RADAR** ..... **3982**
Includes radar; land and global communications; communications theory; and optical communications. For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

**33 ELECTRONICS AND ELECTRICAL ENGINEERING** ..... **3990**
Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

**34 FLUID MECHANICS AND HEAT TRANSFER** ..... **4011**
Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

**35 INSTRUMENTATION AND PHOTOGRAPHY** ..... **4020**
Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

**36 LASERS AND MASERS** ..... **4022**
Includes parametric amplifiers. For related information see also *76 Solid-State Physics.*

**37 MECHANICAL ENGINEERING** ..... **4025**
Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

**38 QUALITY ASSURANCE AND RELIABILITY** ..... **4029**
Includes product sampling procedures and techniques; and quality control.

**39 STRUCTURAL MECHANICS** ..... **4030**
Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

## GEOSCIENCES For related information see also *Space Sciences.*

**42 GEOSCIENCES (GENERAL)** ..... **N.A.**

**43 EARTH RESOURCES AND REMOTE SENSING** ..... **4032**
Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see *35 Instrumentation and Photography.*

**44 ENERGY PRODUCTION AND CONVERSION** ..... **4036**
Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

**45 ENVIRONMENT POLLUTION** ..... **4041**
Includes atmospheric, noise, thermal, and water pollution.

**46 GEOPHYSICS** ..... **4043**
Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see *93 Space Radiation.*

**47 METEOROLOGY AND CLIMATOLOGY** ..... **4045**
Includes weather forecasting and modification.

**48 OCEANOGRAPHY** ..... **4071**
Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also *43 Earth Resources and Remote Sensing.*

## LIFE SCIENCES

**51 LIFE SCIENCES (GENERAL)** ..... **4072**

**52 AEROSPACE MEDICINE** ..... **4072**
Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

**53 BEHAVIORAL SCIENCES** ..... **4076**
Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT** ..... **4077**
Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also *16 Space Transportation.*

**55 SPACE BIOLOGY** ..... **N.A.**
Includes exobiology; planetary biology; and extraterrestrial life.

## MATHEMATICAL AND COMPUTER SCIENCES

**59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)** ..... **N.A.**

**60 COMPUTER OPERATIONS AND HARDWARE** ..... **4081**
Includes hardware for computer graphics, firmware, and data processing. For components see *33 Electronics and Electrical Engineering.*

**61 COMPUTER PROGRAMMING AND SOFTWARE** ..... **4083**
Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

**62 COMPUTER SYSTEMS** ..... **4089**
Includes computer networks and special application computer systems.

**63 CYBERNETICS** ..... **4091**
Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also *54 Man/System Technology and Life Support.*

**64 NUMERICAL ANALYSIS** ..... **4092**
Includes iteration, difference equations, and numerical approximation.

**65 STATISTICS AND PROBABILITY** ..... **4093**
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**66 SYSTEMS ANALYSIS** ..... **N.A.**
Includes mathematical modeling; network analysis; and operations research.

**67 THEORETICAL MATHEMATICS** ..... **N.A.**
Includes topology and number theory.

## PHYSICS For related information see also *Engineering.*

**70 PHYSICS (GENERAL)** ..... **N.A.**
For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

**71 ACOUSTICS** ..... **4094**
Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.*

**72 ATOMIC AND MOLECULAR PHYSICS** ..... **4094**
Includes atomic structure, electron properties, and molecular spectra.

**73 NUCLEAR AND HIGH-ENERGY PHYSICS** ..... **4099**
Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation.*

**74 OPTICS** ..... **4101**
Includes light phenomena and optical devices. For lasers see *36 Lasers and Masers.*

**75 PLASMA PHYSICS** ..... **4104**
Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

**76 SOLID-STATE PHYSICS** ..... **4108**
Includes superconductivity. For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

**77 THERMODYNAMICS AND STATISTICAL PHYSICS** ..... **4113**
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

## SOCIAL SCIENCES

**80 SOCIAL SCIENCES (GENERAL)** ..... **N.A.**
Includes educational matters.

**81 ADMINISTRATION AND MANAGEMENT** ..... **4114**
Includes management planning and research.

**82 DOCUMENTATION AND INFORMATION SCIENCE** ..... **4116**
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software.*

**83 ECONOMICS AND COST ANALYSIS** ..... **4118**
Includes cost effectiveness studies.

**84 LAW, POLITICAL SCIENCE AND SPACE POLICY** ..... **4118**
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

**85 URBAN TECHNOLOGY AND TRANSPORTATION** ..... **N.A.**
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

## SPACE SCIENCES For related information see also *Geosciences.*

**88 SPACE SCIENCES (GENERAL)** ..... **N.A.**

**89 ASTRONOMY** ..... **4118**
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

**90 ASTROPHYSICS** ..... **4121**
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also *75 Plasma Physics.*

**91 LUNAR AND PLANETARY EXPLORATION** ..... **4123**
Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

**92 SOLAR PHYSICS** ..... **4123**
Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation.*

**93 SPACE RADIATION** ..... **4124**
Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

## GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

**99 GENERAL** ..... **4124**

**SUBJECT INDEX** ..... **I-1**

**PERSONAL AUTHOR INDEX** ..... **I-65**

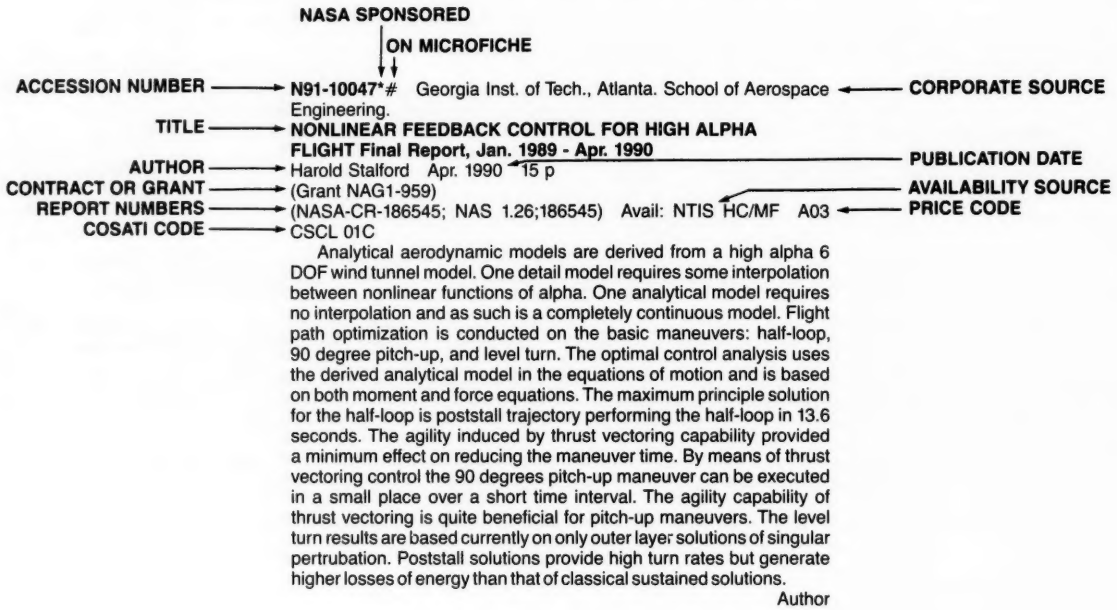
**CORPORATE SOURCE INDEX** ..... **I-75**

**CONTRACT NUMBER INDEX** ..... **I-87**

**REPORT/ACCESSION NUMBER INDEX** ..... **I-91**

**APPENDIX** ..... **A-1**

# TYPICAL CITATION AND ABSTRACT


NASA SPONSORED
ON MICROFICHE
ACCESSION NUMBER
N91-10047*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
CORPORATE SOURCE
TITLE
NONLINEAR FEEDBACK CONTROL FOR HIGH ALPHA FLIGHT Final Report, Jan. 1989 - Apr. 1990
PUBLICATION DATE
AUTHOR
Harold Stalford Apr. 1990 15 p
CONTRACT OR GRANT
(Grant NAG1-959)
AVAILABILITY SOURCE
REPORT NUMBERS
(NASA-CR-186545; NAS 1.26;186545) Avail: NTIS HC/MF A03
PRICE CODE
COSATI CODE
CSCL 01C
Analytical aerodynamic models are derived from a high alpha 6 DOF wind tunnel model. One detail model requires some interpolation between nonlinear functions of alpha. One analytical model requires no interpolation and as such is a completely continuous model. Flight path optimization is conducted on the basic maneuvers: half-loop, 90 degree pitch-up, and level turn. The optimal control analysis uses the derived analytical model in the equations of motion and is based on both moment and force equations. The maximum principle solution for the half-loop is poststall trajectory performing the half-loop in 13.6 seconds. The agility induced by thrust vectoring capability provided a minimum effect on reducing the maneuver time. By means of thrust vectoring control the 90 degrees pitch-up maneuver can be executed in a small place over a short time interval. The agility capability of thrust vectoring is quite beneficial for pitch-up maneuvers. The level turn results are based currently on only outer layer solutions of singular pertrubation. Poststall solutions provide high turn rates but generate higher losses of energy than that of classical sustained solutions.
Author

VOLUME 29 NUMBER 24 / DECEMBER 23, 1991

# Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration



## 01 AERONAUTICS (GENERAL)

**N91-32032#** National Aerospace Lab., Tokyo (Japan).
**PROCEEDINGS OF THE 8TH NAL SYMPOSIUM ON AIRCRAFT COMPUTATIONAL AERODYNAMICS**
Nov. 1990 314 p In JAPANESE and ENGLISH Symposium held in Tokyo, Japan, 25-27 Jun. 1990
(NAL-SP-14; ISSN-0289-260X) Avail: NTIS HC/MF A14

The papers presented at the 8th NAL Symposium on Aircraft Computational Aerodynamics are compiled. The following subject areas are covered: computational fluid dynamics, chemically reacting flow, Direct Simulation Monte Carlo method, rarefied gases, grid generation finite difference theory, finite volume method, finite element method, flow visualization, Navier-Stokes equations, laminar and turbulent flows, cascade flow, etc. For individual titles, see N91-32033 through N91-32069.

**N91-32033#** Tokyo Univ. (Japan). Research Center for Advanced Science and Technology.
**APPLICATION OF AI TO ENGINEERING PROBLEMS** **c63**
Setsuo Ohsuga *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 1-9 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

A computer was developed, which showed its effectiveness as a support tool to solve deterministic problem. This computer accepts computing procedures and numerical quantities written in advance and processes these rapidly. There are some problems, however, that are not suited to be solved in this framework of computer. A typical example of such types of problems is design problem. AI (Artificial Intelligence) is expected to realize a new method of information processing and expand the scope of applications over the current computers involving non-deterministic problems such as design. Recently Expert Systems were developed as an implementation of AI concept. But these systems are not yet powerful enough for being applied to the problems in the real world. The reason why current Expert Systems are not powerful enough is analyzed. A new framework of AI systems is proposed. A system named KAUS is presented with some applications to design problems. Author

**N91-32034#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL SIMULATION OF HYPERSONIC FLOW AROUND H-2 ORBITING PLANE** **c02**
Yukimitsu Yamamoto, Toshio Akimoto, and Naoyuki Suzuki *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 19-26 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

An unmanned winged vehicle for space transportation called H-II Orbiting Plane (HOPE) is studied by National Space Development Agency of Japan (NASDA). Hypersonic CFD analyses were performed for HOPE 63 model proposed by NASDA. The effects of Reynolds number, Mach number, angles of attack, and yaw angles are investigated in detail. In order to use CFD for more practical designing purposes, analyses of control surfaces and gas jets are also made. In addition, calculations of chemically nonequilibrium hypersonic flow are conducted for OREX (Orbiter Re-entry Experiment) model. The purposes of the present study are: (1) to demonstrate the validity of the numerical code for aerothermodynamic heating, (2) to investigate the applicability of CFD for control problems, and (3) to develop reliable gas CFD code. Numerical simulations were performed using flux-split upwind Navier-Stokes code. Author

**N91-32035#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL CALCULATION OF FLOW FOR SCRAMJET ENGINE** **c02**
Tomiko Ishiguro, Satoru Ogawa, and Yasuhiro Wada *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 27-32 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Numerical simulations of reacting flowfields in 2/3-dimensional rectangular scramjet combustors with rearward facing steps are presented. They were carried out by a procedure developed to analyze chemically reacting flow with the Harten-Yee-type TVD scheme. This is based on the complete Navier-Stokes equations and chemical species transport equations, including Rogers' combustion model with two reaction stages, Baldwin-Lomax two layer algebraic eddy viscosity model and diffusion coefficients based on Fick's law. A combustor model in the present calculation is a rectangular scramjet combustor with two rearward facing steps and nine transverse injections of hydrogen. Using a profile in the symmetric plane of the model, a 2-D computation to analyze its flowfield was executed. Also, 3-D computations of the combustors were performed rather roughly within the scope of available computer resources. Results of these computations are described and the calculated pressure distributions on the wall of the symmetric plane are compared with experimental data. Author

**N91-32036#** Nissan Motor Co. Ltd., Tokyo (Japan).
**NUMERICAL SIMULATIONS OF CHEMICALLY REACTING FLOW** **c34**
Kenichi Hirai *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 33-37 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

A summary of the numerical method developed to compute chemically reacting flows is described. The results of computations show that this method is able to predict the basic phenomena induced by fuel injection in a combustor flowfield. Author

**N91-32037#** Tokyo Metropolitan Univ. (Japan). Dept. of Mechanical Engineering.
**ON THE PARALLEL PROCESSING OF DIRECT SIMULATION MONTE CARLO METHOD** **c62**
Masahiro Ota and Tetsuya Tanaka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 39-44 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The parallel processing scheme for the Direct Simulation Monte Carlo (DSMC) method is presented. The parallel computer, a multi CPU computer system, consists of three Transputers. In unsteady

flows of rarefied gas, an ensemble average process is essential to reduce the fluctuation of macroscopic quantities after a number of independent DSMC routines are executed. Therefore, the ensemble average process is parallelized. The acceleration rate of the parallel processing by the present scheme and system is 2.995, and the efficiency of the process is 0.998. Hence, the calculation time for simple unsteady flow of rarefied gas can be reduced to 1/2.995, as compared to the time of a sequential scheme. Author

**N91-32038#** Nippon Electric Co. Ltd., Tokyo (Japan).
**CONSERVATION OF ANGULAR MOMENTUM IN DIRECT SIMULATION MONTE CARLO METHOD** **c72**
Sadamu Saito *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 45-48 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

A new inter-molecular collision scheme is proposed, which conserves angular momentum in a collision cell as well as momentum and kinetic energy. The scheme is composed of two stages of calculations. In a first or conventional scheme, velocities of collision molecules are calculated according to the conservation law of momentum and kinetic energy. In the second stage, positions of the molecules are adjusted in order that the angular momentum is conserved. Author

**N91-32039#** National Aerospace Lab., Tokyo (Japan).
**RAREFIED GAS NUMERICAL WIND TUNNEL 6: DELTA WING** **c09**
Katsuhisa Koura, Emi Kanematsu, and Mikinari Takahira (Daiko Ltd., Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 49-52 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The rarefied gas numerical wind tunnel constructed on the National Aerospace Laboratory Numerical Simulation System with the universal code described using the null-collision direct-simulation Monte Carlo method is used for the simulation of rarefied gas flows around a flat-plate delta wing at a large angle of attack. Some flowfield properties shown by computer graphics are presented. Author

**N91-32040#** Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
**AN INCOMPRESSIBLE FLOW SOLVER** **c34**
Wei Jia, Yoshiaki Nakamura, and Michiru Yasuhara *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 53-62 (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

An incompressible flow solver is presented based on the primitive variable formulation and its several applications to both fundamental and practical flow problems. The coupled form of the momentum and energy equations written in generalized coordinates are solved by the finite difference method, where a two-step time integration method with second order accuracy, the approximation of convective terms by the QUICK method, and an accurate, fast convergence pressure Poisson solver are employed, as well as an efficient multi-domain technique. Studies of flows on a flat plate and around a circular cylinder verified the accuracy of the present procedures. Treatments of flow problems with complicated geometry are also presented for several examples. Author

**N91-32041#** Kyushu Univ., Fukuoka (Japan). Dept. of Mechanical Engineering for Power.
**NUMERICAL SIMULATION OF UNSTEADY COMPRESSIBLE VISCOUS FLOWS USING AN IMPLICIT UPWIND RELAXATION SCHEME** **c34**
Masato Furukawa, Takashi Nakano, and Masahiro Inoue *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 69-75 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

An implicit upwind scheme was developed for simulations of unsteady compressible viscous flows. The inviscid fluxes were evaluated using a highly accurate upwind scheme based on a Total Variation Diminishing (TVD) finite volume formulation with the Roe's approximate Riemann solver. The algebraic turbulence model of Baldwin and Lomax was used. A zonal approach with composite grids was implemented to simplify grid generations. A new time linearization of the inviscid fluxes evaluated by the Roe's Riemann solver is presented. Unfactored implicit equations are solved by a pointwise relaxation method. To obtain time accurate solutions, 30 inner iterations were performed at each time step. Numerical examples are presented for unsteady flows in a transonic turbine cascade where periodic unsteadiness is caused by the trailing edge vortex shedding. Author

**N91-32042#** Institute of Computational Fluid Dynamics, Tokyo (Japan).
**SURFACE GRID GENERATION BASED ON UNSTRUCTURED GRID** **c61**
Masahiro Suzuki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 77-82 In JAPANESE; ENGLISH summary Previously announced in IAA as A90-45931 (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

A new approach to surface grid generation was developed. First, the unstructured grids are generated on the surface. Then the partial differential equations are mapped on these grids and numerical solutions are acquired. Finally, the structured grids are constructed by searching for the contours inside the solution domain. Examples demonstrate that smooth surface grids are obtainable. In addition, grid space control was achieved by the use of the weight function. Author

**N91-32043#** Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
**FINITE DIFFERENCE NUMERICAL PREDICTION OF AERODYNAMICS FOR AIRFOIL FLYING OVER WAVY WALL** **c02**
Kyoko Nitta, Shigenori Ando, and Hiroshi Waku *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 83-89 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The lift on an airfoil flying over a wavy wall surface is calculated using a finite difference method, which was developed by J. Nakamichi to improve LTRAN2 evolved by W. F. Ballhaus and P. M. Goorjian. Numerical computations include cases of a flat plate over a flat solid wall prior to the cases of a moving wavy wall. Modification of the grid generating system is the major reason for applying Nakamichi's method to our problem. The weak compressibility (M sub infinity equals 0.1 approximately 0.3) is considered, but nonlinearity is neglected in our calculations. The calculated results are compared with those obtained by the lifting surface theory of M. Ichikawa et al. The agreements between results and theory are quite satisfactory. Author

**N91-32044#** Institute of Computational Fluid Dynamics, Tokyo (Japan).
**SEVERAL ISSUES OF VISUALIZATION TECHNIQUES IN COMPUTATIONAL FLUID DYNAMICS 2** **c34**
Susumu Shirayama *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 97-102 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Several flow visualization techniques using the Lagarangian were developed for analyzing the numerical solutions of unsteady

flow fields computed by the Eulerian approach. The author shows how these methods can be used to assess the validity of solutions and to extract the nature of flow fields. It was found that the extensive use of flow field animation is a requirement for the analysis and validation of unsteady flow fields. Detailed algorithms for the flow visualization are introduced. Author

**N91-32045#** National Aerospace Lab., Tokyo (Japan).
**AERODYNAMIC DESIGN OF NON-PLANAR WING BY INVERSE METHOD WITH NAVIER-STOKES EQUATION** **c05**
Takashi Kaiden, Jun Ogino (Mitsubishi Heavy-Industries Ltd., Tokyo, Japan ), and Susumu Takanashi *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 103-107 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

For the design of non-planar wings, it is indispensible to use the Navier-Stokes code for the viscous effect of corner flow and the induced separation. Presented here is the design of a non-planar wing using an inverse method with a Navier-Stokes code instead of the usual full potential code. Author

**N91-32046#** National Aerospace Lab., Tokyo (Japan).
**NAVIER-STOKES SIMULATION FOR COMPLETE AIRCRAFT CONFIGURATION** **c05**
Susumu Takanashi and Keisuke Sawada (Kawasaki Heavy Industries Ltd., Kagamihara, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 109-113 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Numerical simulation of transonic viscous flow using a block structured grid system is carried out for a complete aircraft configuration. The Navier-Stokes equations are numerically solved by the second order accurate finite volume method based on a Total Variation Diminishing (TVD) upward scheme. To achieve accuracy of convergence, a planar Gauss-Seidel relaxation method is adopted. A two equation eddy viscosity model is used for turbulent flow computations. Author

**N91-32047#** Fuji Heavy Industries Ltd., Utsunomiya (Japan).
**BLENDED WING-BODY CONFIGURATION DESIGN USING TRANSONIC INVERSE CODE** **c05**
Yosuhiro Tani, Yasuhiro Koshioka, and Hidehiro Hirose *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 115-120 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

An iterative procedure is described for a three dimensional wing-body configuration using a three dimensional transonic inverse method with target pressure distribution. In this application, it is combined with a full potential analysis code. Some of the design results for a conventional and a blended wing-body configuration are presented. Also, a finite volume Euler solver is applied to analyze the designed configurations. Author

**N91-32048#** Kawasaki Heavy Industries Ltd., Gifu (Japan).
**THE ROLE OF COMPUTATIONAL FLUID DYNAMICS IN AERONAUTICAL ENGINEERING (8): A MIXED COMPRESSION INLET FOR A SUPERSONIC AIRPLANE** **c34**
Akira Fujimoto, Nobuo Niwa, and Keisuke Sawada (Tohoku Univ., Sendai, Japan ) *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 121-126 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

A numerical investigation of a supersonic mixed-compression inlet is carried out. The inlet is designed for Mach 2.5 by applying the Method of Characteristics. Realistic ramp bleed and throat bypass systems are simulated by a two-dimensional, finite volume, multiblock Total Variation Diminishing (TVD) Navier-Stokes code. From the calculations, the roles of ramp bleed and throat bypass systems are revealed. The mechanism for improving the pressure recovery ahead of an inlet upstart is found for the first time in detail. The results show that the throat gap, or slot, constructs an optimum equivalent wall configuration automatically by the flow conditions around the systems. This result can be obtained because of the great advantage of the computational fluid dynamics (CFD) approach. Author

**N91-32049#** Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
**SUPERSONIC INLET FLOW COMPUTATIONS WITH CAVITY** **c02**
Shinichi Kuroda and Kozo Fujii (Tokyo Univ., Japan ) *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 127-132 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The supersonic inlet plays a partial or whole role in the air compression process of supersonic/hypersonic air-breathing engines and is a key factor in engine performance. The flow fields of a supersonic inlet which has a bleed chamber are simulated using a zonal method. The zonal method can connect zones with high accuracy and permit the movement of dicontinuities across the zonal boundary. Author

**N91-32050#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL SIMULATION ANALYSIS OF SIDEWALL EFFECTS IN TWO-DIMENSIONAL WIND TUNNELS** **c02**
Junichi Miyakawa, Miho Shimizu, Susumu Takanashi, and Kanichi Amano (Japan Aircraft Development Corp., Tokyo.) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 133-140 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Computational aerodynamics has evolved to be a practical design tool comparable to wind tunnel testing, and it has played an important role in actual aircraft design stages. In addition to the design tool, there is another important field of application for computational fluid dynamics, which is as an analytical tool in wind tunnel testing. Sidewall effects in 2-D wind tunnel testing are described, and aerodynamic effects in 2-D are evaluated. Author

**N91-32051#** Institute of Computational Fluid Dynamics, Tokyo (Japan).
**THE THREE DIMENSIONAL NAVIER-STOKES SIMULATIONS OF FLOW OVER A WING WITHOUT ANY TURBULENT MODELLING** **c02**
Takuya Sakuragi, Katuya Isii, and Kunio Kuwahara (Tokyo Univ., Japan ) *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 141-146 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Direct simulation without any turbulence models has become an effective method to study 3-D unsteady flow fields at high Reynolds numbers. This progress was made possible by the speed and memory capabilities of present-generation supercomputers and the development of improved computational algorithms and techniques. The unsteady shock-boundary interaction in the viscous transonic flow over the ONERA-M6 wing attached to a wall is investigated using a finite difference approximation of the 3-D Navier-Stokes equations. For this purpose, the LU-ADI factorization method was used with a Chakravarthy and Osher type total variation diminishing (TVD) scheme in the explicit term, and got the time-average of the unsteady flow field without using any turbulent eddy viscosity models. As the number of grid points gets large, the CP-curves of the time-average become close to the results of the experiment. Author

**N91-32052#** Kyoto Univ. (Japan). Dept. of Aeronautics.
**NUMERICAL ANALYSIS OF BUBBLY LIQUID IN CONVERGENT-DIVERGENT NOZZLE** **c34**

Ryuji Ishii, Yoshikuni Umeda, Shigeki Morioka, and Natsuo Hatta *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 147-151 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Flow of bubbly liquid in a divergent-convergent nozzle is investigated numerically. First, a steady flow is obtained. Then, small pressure fluctuations are imposed on the flow at the nozzle inlet. It is found that the voidage waves are induced by the applied pressure fluctuations. They propagate downstream through the nozzle with the same velocity as that of the bubbles. Theoretically, voidage waves are expected to be amplified and the flow becomes unstable in the throat region where the velocity slip between the liquid and the gas bubbles is present. Numerically, however, the unstable behavior of the voidage wave was not found at least in the present numerical simulations. This might come from the fact that the artificial viscosity involved in the numerical scheme tends to suppress the amplification of unstable waves. Author

**N91-32053#** National Aerospace Lab., Kakuda (Japan).
**NUMERICAL TREATMENT OF LAMINAR FLOW IN CURVED RECTANGULAR CHANNELS WITH ENTRANCE REGION c34**
Hitoshi Yamada, Hiroshi Ishigaki, and Munekazu Mochizuki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 153-157 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Developing laminar fluid flow in a curved square duct is studied using a finite difference method. A power law scheme, the control volume method, is used inside the computational domain. Dean number, which is based upon the inlet bulk velocity, curvature ratio is from 100 to 500, and the aspect ratio of the duct is 1.0 with a curvature ratio of 10.0. Developing flow has a one-pair vortex secondary flow with Dean number 100, but in the case of Dean number 500, it has a two-pair vortex flow pattern at higher degree regions that 65 degrees from the duct inlet, which is caused by centrifugal force instability. Experimental data is compared with the computer calculations and it is in good agreement with experimental results, except in the inlet and the outlet region of the curved duct. This is considered to be the reason why the computed outlet velocity is different from the experiment and it is assume that the duct flow has symmetric characteristics. The experimental flow, however, has an asymmetric vortex pattern near the duct outlet regions. Author

**N91-32054#** National Aerospace Lab., Kakuda (Japan).
**DEVELOPING LAMINAR FLOW AND HEAT TRANSFER IN ORTHOGONALLY ROTATING SQUARE DUCTS c34**
Hiroshi Tamura and Hiroshi Ishigaki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 159-163 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Three dimensional parabolized Navier-Stokes equations and energy equations were numerically solved for the flow and heat transfer on the laminar flow of air in a square duct rotating about a perpendicular axis. Coriolis force produces the secondary flow and flow instability which affect the friction and heat transfer in the duct. The flow can be characterized by two parameters K sub L (= Re/sq. root Ro) and Ro. Here Re and Ro are Reynolds and Rossby number, respectively. The predictions were made for a wide range of these two parameters. Author

**N91-32055#** National Aerospace Lab., Kakuda (Japan).
**FLOW AND HEAT TRANSFER IN A CURVED ANNULAR PIPE c34**
Munekazu Mochizuki and Hiroshi Ishigaki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 165-171 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Navier-Stokes computations are reported for the laminar flow in a curved annular pipe. Predictions are presented of flow and heat transfer in the fully developed regions. Changes of friction factor, flow pattern, Nusselt number, and temperature field due to Dean number are discussed. Author

**N91-32056#** National Aerospace Lab., Kakuda (Japan).
**TURBULENCE MODEL CALCULATIONS ON THE EFFECTS OF BODY FORCES ON TURBULENT FLOWS IN A PIPE c34**
Hiroshi Ishigaki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 173-179 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The effects of centrifugal and Coriolis forces on fully developed turbulent flow in a curved or an orthogonally rotating pipe are studied numerically by using a standard k-epsilon turbulence model. Computational results are compared with the available experimental data on flow patterns, friction factor, and velocity profiles. Author

**N91-32057#** National Aerospace Lab., Kakuda (Japan).
**FULLY DEVELOPED MIXED CONVECTION IN A HORIZONTAL PIPE c34**
Hiroshi Ishigaki and Munekazu Mochizuki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 181-185 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The effects of buoyancy on fully developed laminar flow and heat transfer in a horizontal pipe are studied numerically. The wall thermal conditions are an axially constant wall heat flux and a peripherally constant wall temperature. Computational results are compared with the available experimental data on flow patterns, friction factor, Nusselt number, velocity profiles, and temperature profiles. Author

**N91-32058#** Ship Research Inst., Tokyo (Japan).
**WALL FUNCTION METHOD WITH CONSERVATION PROPERTY c34**
Takanori Hino *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 187-192 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The Navier-Stokes equations and the continuity equation express conservation of momentum and mass, respectively. Therefore, numerical schemes to solve these equations have to conserve these quantities numerically to get an accurate solution. For simulations of turbulent flows, various kinds of turbulence models are commonly introduced in the numerical scheme. Some models are used with the wall function method, which can reduce computing costs drastically. This, however, may violate the above mentioned conservation property, because the governing equations are not solved in the region where the wall function method is applied. A wall function method with the conservation property is proposed. The numerical fluxes on and adjacent to the wall are determined such that the wall shear stress obtained from the law of the wall is coupled with the governing equations. The solution procedure is described with the numerical results for a 2-D channel flow and the flow around a 2-D flat plate. Author

**N91-32059#** Tokyo Noko Univ. (Japan).
**ACTIVE CONTROL OF VORTEX SHEDDING FREQUENCY BY A SPLITTER PLATE c34**
Norio Arai, Masatomo Komatsu, and Takashi Tani *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 193-196 In

JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The structure is numerically studied of the wake behind a square section cylinder mounting with a splitter plate. A two dimensional incompressible Navier-Stokes equation is solved numerically. The interaction between the transverse flow (behind the body) and the splitter has considerable influence on the rearrangement of the vortex street. With the splitter plate located moderately, the peak value of lift coefficient is reduced to 40 pct. of the isolated body case. Also, the frequency of the variation of lift coefficient becomes smaller. The optimized location of the splitter plate is found.
Author

**N91-32060#** Fuji Heavy Industries Ltd., Utsunomiya (Japan).
**A NUMERICAL SIMULATION OF TWO DIMENSIONAL SHEAR LAYER** **c34**
Yasuhiro Koshioka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 197-202 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

A numerical simulation of the two dimensional (in the sense of mean flow) shear layer is carried out using Arakawa's method. The processes of the growing disturbances and their interactions in the shear layer are clearly simulated. The results show that some combinations of the disturbances show three dimensionality and others not. Finally, the conditions of small disturbances to deform two dimensional shear layer three dimensionally is discussed.
Author

**N91-32061#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL SIMULATION OF SHOCK WAVE EMANATING FROM A SQUARE SHOCK TUBE** **c34**
Akihisa Abe, Katsuhiro Itoh, and Kazuyoshi Takayama (Tohoku Univ., Sendai, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 203-208 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The flow field behind a shock wave emitted from a square shock tube was studied. Being 3-D, various phenomena were observed for axisymmetric flow such as distorted vortex ring structures generated from the shock tube exit, shock wave deformation, and a variety of flow structures behind the shock wave. If the generative mechanisms of distorted vortex ring and flows from the shock tube are clear, this also contributes to the technical advancement, regarding the mixture of different chemical species. The shock wave emanating from a square shock tube was studied in numerical simulation and shock tube experiment. In order to simulate these flow fields, a second order upwind Total Variation Diminishing (TVD) finite difference scheme was used. The TVD scheme, having been used for 2-D problems, was extended to 3-D and applied to Euler equations. The computational domain of 60 x 60 x 60 grid points covers a quarter of the shock tube cross section. As an initial configuration, a normal shock wave with Mach 1.5 was taken. The numerical results were compared with data from optical measurements. Good qualitative agreement was obtained between numerical and experimental results.
Author

**N91-32062#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL SIMULATION OF THERMAL CONVECTION IN A RECTANGULAR DUCT FLOW** **c34**
Kiyoshi Yamamoto, Iwao Hosokawa, and Yoshinori Tanaka (University of Electro-Communications, Chofu, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 209-214 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Numerical simulation of thermal convection in a horizontal rectangular duct flow heated from both bottom and sides is carried out using a method based on the Fourier spectral method. It is shown that the convective secondary flow is induced not only by the Rayleigh-Benard instability but by the natural convection near the duct's side walls. As a result, almost stationary longitudinal convective rolls are achieved in the flow when the Reynolds numbers are large values, 500 and 220. On the other hand, when the Reynolds number is a smaller value, 90, the rolls fluctuate chaotically in space and time; then the time averaged secondary flow is almost vanishing and the fluid temperature widely constant in the central part of the duct.
Author

**N91-32063#** Tohoku Univ., Sendai (Japan). Dept. of Mechanical Engineering.
**NUMERICAL TURBULENT SIMULATIONS OF UNSTEADY TRANSONIC CASCADE FLOWS** **c34**
Satoru Yamamoto, Hisaaki Daiguji, and Kouichi Ishizaka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 215-220 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

A numerical simulation of unsteady turbulent flows through a supersonic compressor cascade is presented. The fundamental equations used are the compressible Navier-Stokes equations of contravariant velocities and two equation kappa epsilon turbulence model. These equations are numerically discretized by the implicit time marching method in which some efficient numerical schemes are used. Some of them are the Newton iterative algorithm for unsteady calculation, a new shock capturing scheme for obtaining oblique shocks more sharply and a numerical technique, so called know how to simulate the turbulent transition due to the shocks. In addition to the numerical schemes, a numerical simulator was developed to make the animation during the flow calculation by using a graphic workstation. This system is also introduced.
Author

**N91-32064#** National Aerospace Lab., Tokyo (Japan).
**UNSTEADY FLOW ANALYSIS IN TWO-DIMENSIONAL COMPRESSOR CASCADE** **c34**
Masahiro Fukuda, Kazuo Kikuchi, Atsuhiro Tamura, Keisuke Hashimoto, and Akinori Matsuoka (Kawasaki Heavy Industries Ltd., Kakamigahara, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 221-226 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The unsteady flow field with large separation in highly loaded transonic compressor cascade is numerically analyzed by the implicit time marching method which also solves 2-D Navier-Stokes equations. It is effective for the aerodynamic design of improved compressor cascade which makes possible accurate prediction of aerodynamic performances such as total pressure loss or exit flow angle, even those with large boundary layer separation. Several computational trials are studied, including the unsteady simulation without using thin layer approximation or any turbulence models.
Author

**N91-32065#** National Aerospace Lab., Tokyo (Japan).
**ANALYSIS OF THE AERODYNAMIC PERFORMANCE OF COUNTER-ROTATING PROPELLER BY MEANS OF VORTEX LATTICE METHOD** **c02**
Shigeru Saito and Yasuhiro Mizobuchi (Tokyo Univ., Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 227-232 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Aerodynamic performance of a counter rotating propeller was calculated by means of Vortex Lattice Method. The new wake system of each rotor was constructed using a prescribed wake model by Kocurek-Berkowitz-Harris, which is well known as an empirical wake system of helicopter rotor with low aspect ratio blades. The vortex filaments including a blade tip vortex were treated as vortex tubes with the finite vortex core in order to

avoid the numerical divergence in the calculation. The calculated results for a single rotating propeller have shown good agreement with experimental results in the subsonic speed range. The results for counter rotating propeller were compared with those by Local Circulation Method and wind tunnel test results and shown good correlation.
Author

**N91-32066#** National Aerospace Lab., Tokyo (Japan).
**NAVIER-STOKES ANALYSIS FOR FLOWFIELD AROUND HOVERING ROTOR** **c02**
Takashi Aoyama, Keiji Kawachi, and Shigeru Saito *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 233-238 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The 3-D Navier-Stokes equations are solved to analyze the flow field around a blade tip of a hovering rotor. The eddy viscosity is calculated by using the Baldwin-Lomax zero equation turbulence model and the q-w two equation turbulence model developed by Coakley. An implicit finite difference method is used to solve the equations and the algebraic method is adopted to generate the grids. The effect of wake outside of the grid is taken into consideration by correcting the equivalent geometric angle of attack along the blade radius. Its value is estimated by using prescribed vortex lattice method (VLM) or Local Circulation Method (LCM). The pressure distribution on blade surface predicted by the present method are similar to other theoretical results and are in reasonable agreement with the experimental data. In addition, the present results are compared with the results calculated by the Euler code. In transonic cases, some differences are shown in the results.
Author

**N91-32067#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL ANALYSIS OF THREE-DIMENSIONAL CASCADE FLOW** **c34**
Yuichi Matsuo *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 239-244 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

Three dimensional viscous flows in turbomachinery cascades are numerically studied by solving compressible Navier-Stokes equations. An implicit finite difference code based on a high Total Variations Diminishing (TVD) scheme was developed and applied. Computations are successfully carried out for a linear turbine cascade. In order to enhance numerical accuracy for turbulence phenomena, three cases are tested: (1) laminar; (2) turbulence using Baldwin-Lomax model; and (3) turbulence using Chien's kappa-epsilon model. Numerical results are compared with experimental data. Computed surface flows clearly capture secondary flow characteristics in a turbine cascade, and show good agreement with experimental oil flow patterns. The aerodynamic performances such as total pressure loss are predicted fairly well. However, advanced work would be needed to improve quantitative accuracy of the numerical analysis.
Author

**N91-32068#** National Aerospace Lab., Tokyo (Japan).
**NAVIER-STOKES COMPUTATIONS OF THREE-DIMENSIONAL TURBINE CASCADE FLOWS** **c34**
Kazuo Kikuchi, Osamu Nozaki, Atsuhiro Tamura, Takehiko Nagayama, and Yoshiaki Miyake (Mitsubishi Heavy-Industries Ltd., Nagasaki, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 245-248 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

The Navier-Stokes code was used to compute 3-D turbine stator flows. The computational results were compared with three experimental results from the linear cascade, the turbine bowed stator, and the high work turbine stator. The results show that the Navier-Stokes code has the significant potential to study the complicated viscous flow mechanism. In order to get more quantitative results, it is surmised that the use of more powerful supercomputers and the development of the turbulence models are needed.
Author

**N91-32069#** National Aerospace Lab., Tokyo (Japan).
**APPLICATION OF 3-D NAVIER-STOKES COMPUTATION TO TURBINE VANE DESIGN** **c34**
Kazuo Kikuchi, Osamu Nozaki, Atsuhiro Tamura, Koji Matsunaga, Hisao Takeuchi, Takasi Maya, and Ruriko Yamawaki (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 249-255 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

An application of the 3-D Navier-Stokes computations in designing a turbine vane cascade is presented. The accurate prediction of the cascade flow characteristics such as total pressure loss and outlet flow angle is important for aerodynamic engineers to evaluate the performance of airfoil contour shapes. A curvilinear leaned stator vane, adopted to suppress the secondary flow and reduce the losses, is studied in detail. The advanced design based on the 3-D Navier-Stokes computations succeeded to reduce the losses greatly showing the capability of a code as a design tool.
Author

**N91-32070*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**PREDICTION TECHNIQUES FOR JET-INDUCED EFFECTS IN HOVER ON STOVL AIRCRAFT**
Douglas A. Wardwell and Richard E. Kuhn (Kuhn, Richard E., San Diego, CA ) Aug. 1991 25 p
(NASA-TM-102818; A-90146; NAS 1.15:102818) Avail: NTIS HC/MF A03 CSCL 01B

Prediction techniques for jet induced lift effects during hover are available, relatively easy to use, and produce adequate results for preliminary design work. Although deficiencies of the current method were found, it is still currently the best way to estimate jet induced lift effects short of using computational fluid dynamics. Its use is summarized. The new summarized method, represents the first step toward the use of surface pressure data in an empirical method, as opposed to just balance data in the current method, for calculating jet induced effects. Although the new method is currently limited to flat plate configurations having two circular jets of equal thrust, it has the potential of more accurately predicting jet induced effects including a means for estimating the pitching moment in hover. As this method was developed from a very limited amount of data, broader applications of the method require the inclusion of new data on additional configurations. However, within this small data base, the new method does a better job in predicting jet induced effects in hover than the current method.
Author

**N91-32071*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**COMPARISONS OF ELASTIC AND RIGID BLADE-ELEMENT ROTOR MODELS USING PARALLEL PROCESSING TECHNOLOGY FOR PILOTED SIMULATIONS**
Gary Hill, Ronald W. DuVal, John A. Green, and Loc C. Huynh (Advanced Rotorcraft Technology, Inc., Mountain View, CA.) Jun. 1991 19 p Presented at the Sixteenth European Rotorcraft Forum, Glasgow, Scotland, 18-20 Sep. 1990
(NASA-TM-102859; A-90266; NAS 1.15:102859) Avail: NTIS HC/MF A03 CSCL 01B

A piloted comparison of rigid and aeroelastic blade-element rotor models was conducted at the Crew Station Research and Development Facility (CSRDF) at Ames Research Center. A simulation development and analysis tool, FLIGHTLAB, was used to implement these models in real time using parallel processing technology. Pilot comments and quantitative analysis performed both on-line and off-line confirmed that elastic degrees of freedom significantly affect perceived handling qualities. Trim comparisons show improved correlation with flight test data when elastic modes

are modeled. The results demonstrate the efficiency with which the mathematical modeling sophistication of existing simulation facilities can be upgraded using parallel processing, and the importance of these upgrades to simulation fidelity. Author

# 02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

**N91-32072#** Wright Lab., Eglin AFB, FL. Armament Directorate.

**THIN LAYER NAVIER-STOKES SOLUTIONS FOR TRANSONIC MULTIBODY INTERFERENCE Interim Report, Aug. 1990 - Jan. 1991**

Prisca L. Lynch and Magdi H. Rizk Mar. 1991 11 p Previously announced in IAA as A91-21357

(AF Proj. 2567)

(AD-A234252; WL/MN-TR-91-23) Avail: NTIS HC/MF A03 CSCL 20/4

A thin layer, Navier Stokes flow solver was used to predict the aerodynamics about interfering bodies. Surface pressure distributions compared very well with available experimental data for freestream Mach numbers between 0.60 and 1.20 at an interbody separation distance of 0.8 diameters. Five separate interference regions were identified which contribute to the total interference force, which was an attractive force for all cases investigated. In general, the level of interference increases with increasing free stream Mach number, and decreases with increasing separation distance. GRA

**N91-32073#** Association Aeronautique et Astronautique de France, Paris.

**AERODYNAMIC COMPUTATION POST PROCESSING TOOLS [DES OUTILS DE POST-TRAITEMENT DE CALCUL EN AERODYNAMIQUE]**

F. Bartak, D. Begis, J. M. Chantrel, and Ph. Dewagenaere (Electricite de France, Chatou.) 1989 20 p In FRENCH Presented at 26th Colloque d'Aerodynamique Appliquee, Toulouse, France, 23-25 Oct. 1990 Previously announced in IAA as A91-19588

(AAAF-NT-89-20; ISBN-2-7170-0953-1; ISSN-0243-0177; ETN-91-99961) Avail: NTIS HC/MF A03; CEDOCAR, Section des Diffusions, 26 Blvd Victor, 75996 Paris Armees, France HC 15 francs

The different features, software implementation and algorithms of the TIGRE package, tool for post processing, and PABLO, tool for numerical modeling of fluid mechanics using finite differences, are presented. These programs are installed at a great number of industrial sites. Much research and development to increase algorithmic possibilities and interactive graphics, particularly in the portability and use of local features of three dimensional terminals, is being pursued. ESA

**N91-32074*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**AN EXPERIMENTAL STUDY OF NATURAL AND FORCED MODES IN AN AXISYMMETRIC JET Ph.D. Thesis - Case Western Reserve Univ.**

Ganesh Raman, Edward J. Rice, and Eli Reshotko (Case Western Reserve Univ., Cleveland, OH.) Sep. 1991 196 p

(NASA-TM-105225; E-6091; NAS 1.15:105225) Avail: NTIS HC/MF A09 CSCL 01A

The experiment consisted of two parts. The first part was an effort to study naturally occurring instability modes in the axisymmetric shear layer of a high Reynolds number turbulent jet. Untripped (transitional) and tripped (turbulent) nozzle exit conditions, both with 0.1 percent core turbulence, were studied. For the turbulent nozzle exit boundary layer case, the core turbulence, was varied systematically from 0.1 to 5 percent of the jet exit velocity. The region up to the end of the potential core was dominated by the axisymmetric mode. The azimuthal modes grew rapidly but dominated only downstream of the potential core region. For the jet excited by natural disturbances, the energy content of the higher order modes (m is less than 1) was significantly lower than that of the axisymmetric and m = +/-1 modes. The initial boundary layer had a profound effect on the natural jet evolution and its excitability. The shorter potential core allowed the jet in the transitional case to support helical disturbances closer the nozzle exit than the turbulent case. The natural jet evolution was found to remain unaffected for varying initial core turbulence over the range of 0.15 to 5 percent of the jet velocity. Target modes for efficient excitation of the jet were determined from the results of the naturally occurring jet instability mode experiments. The second part of this work describes an effort to control the axisymmetric shear layer by artificially exciting target modes. Under optimum conditions, two-frequency excitation is indeed more effective than single frequency plane wave excitation as far as jet mixing is concerned. At high amplitudes of fundamental and subharmonic forcing, the subharmonic augmentation and the axial location of the peak were independent of the initial phase difference. Two-frequency excitation also has its limitations, since axisymmetric waves are damped beyond the potential core. Higher spreading rates are obtained when multi-modal forcing is applied. Author

**N91-32075*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**UNSTEADY FLOWFIELD OF A PROPFAN AT TAKEOFF CONDITIONS**

M. Nallasamy (Sverdrup Technology, Inc., Brook Park, OH.) and J. F. Groeneweg 1991 14 p Presented at the 6th International Symposium on Unsteady Aerodynamics, Aeroacoustics and Aeroelasticity of Turbomachines and Propellers, Notre Dame, IN, 15-19 Sep. 1991; sponsored by the International Union of Theoretical and Applied Mechanics

(Contract NAS3-25266)

(NASA-TM-105223; E-6540; NAS 1.15:105223) Avail: NTIS HC/MF A03 CSCL 01A

The unsteady flowfield of a propfan operation at takeoff conditions with angular inflow is examined by solving the three-dimensional Euler equations. The operating conditions considered are: Mach no. = 0.31, advance ratio = 1.6, and inflow angle to the propfan = 8.3 deg. The predicted results clearly show the cyclic variations of the blade power and thrust coefficients due to angular inflow. The flow changes from blade passage to passage are illustrated in terms of static pressure contours. The predicted blade surface pressure waveforms were compared with flight measurements. The predictions at the inboard radial station, r/R = 0.68, show reasonable agreement with flight data. At the outboard radial station, r/R = 0.95, where the interactions of the tip vortex, the tip-region flow and the blade wake appear to result in a complex nonlinear measured response. The prediction shows poor agreement. Author

**N91-32076#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. Mathematische Verfahren und Datentechnik.

**DETERMINATION OF AERODYNAMIC CHARACTERISTICS FROM ATTAS FLIGHT DATA GATHERING FOR GROUND-BASED SIMULATOR**

Ravindra Jategaonkar (Technische Univ., Brunswick, Germany, F.R.) May 1991 58 p

(DLR-FB-91-15; ISSN-0939-2963; ETN-91-90045) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 25 DM

The results of estimations of aerodynamic characteristics of the research aircraft Advanced Technologies Testing Aircraft System (ATTAS) from flight test data are reported. The emphasis was on validating and updating the aerodynamic data base predicted by wind tunnel and analytical methods. The estimation

of aerodynamic derivatives, carried out by applying a nonlinear maximum likelihood parameter estimation method, is based on the six degree of freedom equations of aircraft motion and a one point aerodynamic model in terms of nondimensional derivatives. From the flight estimated aerodynamic derivatives, an aerodynamic data base is computed in a table look up form suitable for integration in the ground based simulator. The aerodynamic characteristics estimated from flight data are compared with those predicted by wind tunnel and analytical methods. ESA

**N91-32077*#** Sverdrup Technology, Inc., Brook Park, OH.
**A COMPARISON OF THE ANALYTICAL AND EXPERIMENTAL PERFORMANCE OF THE SOLID VERSION OF A COOLED RADIAL TURBINE**
Lizet Tirres Sep. 1991 10 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; cosponsored by AIAA, SAE, ASME, and ASEE Previously announced in IAA as A91-44133
(Contract NAS3-25266)
(NASA-CR-187195; E-6521; NAS 1.26:187195; AIAA-91-2133)
Avail: NTIS HC/MF A02 CSCL 01A

An evaluation of the aerodynamic performance of the solid version of an Allison-designed cooled radial turbine was conducted at NASA Lewis' Warm Turbine Test Facility. The resulting pressure and temperature measurements are used to calculate vane, rotor, and overall stage performance. These performance results are then compared to the analytical results obtained by using NASA's MTSB (MERIDL-TSONIC-BLAYER) code. Author

**N91-32078*#** Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
**INVESTIGATION OF RADIATIVE INTERACTIONS IN SUPERSONIC INTERNAL FLOWS Progress Report, period ending 31 May 1991**
Surendra N. Tiwari and A. M. Thomas Oct. 1991 153 p
(Grants NAG1-363; NAG1-423)
(NASA-CR-188920; NAS 1.26:188820) Avail: NTIS HC/MF A08 CSCL 01A

Analyses and numerical procedures are presented to study the radiative interactions of absorbing emitting species in chemically reacting supersonic flow in various ducts. The 2-D time dependent Navier-Stokes equations in conjunction with radiative flux equation are used to study supersonic flows undergoing finite rate chemical reaction in a hydrogen air system. The specific problem considered is the flow of premixed radiating gas between parallel plates. Specific attention was directed toward studying the radiative contribution of H2O, OH, and NO under realistic physical and flow conditions. Results are presented for the radiative flux obtained for different gases and for various combination of these gases. The problem of chemically reacting and radiating flows was solved for the flow of premixed hydrogen-air through a 10 deg compression ramp. Results demonstrate that the radiative interaction increases with an increase in pressure, temperature, amount of participating species, plate spacing, and Mach number. Most of the energy, however, is transferred by convection in the flow direction. In general the results indicate that radiation can have a significant effect on the entire flow field. Author

**N91-32079*#** Pennsylvania State Univ., University Park. Gas Dynamics Lab.
**SUPERSONIC MIXING ENHANCEMENT BY VORTICITY FOR HIGH-SPEED PROPULSION Final Report, 1 Apr. 1988 - 30 Jun. 1991**
Gary S. Settles Oct. 1991 51 p
(Grant NAG1-872)
(NASA-CR-188920; NAS 1.26:188920) Avail: NTIS HC/MF A04 CSCL 01A

The results of a three year study on vortex enhancement of supersonic mixing are discussed. Recent interests in compressible mixing has spurred research in the field of high speed shear layers. It was established that shear layer growth diminishes with increasing convective Mach number; this Mach number is the relative Mach number of the large scale structures in the shear layer with respect to the Mach numbers on either side of the shear layer. The purpose was to evaluate the effect of swirl on compressible mixing rates. Previously analytical and experimental results seem to indicate that swirling flow may significantly modify the shear layer, in some cases resulting in enhanced mixing. Previous studies of the effect of swirl on compressible mixing were incomplete since the amount of swirl in the flowfield was not quantified. This study was undertaken to conclusively determine the effect of swirl on supersonic mixing, including the quantification of the swirl. Preliminary results indicate that the swirl modestly enhances the mixing rates. Author

**N91-32080*#** Pennsylvania State Univ., University Park. Gas Dynamics Lab.
**AN EXPERIMENTAL STUDY OF FLUCTUATING PRESSURE LOADS BENEATH SWEPT SHOCK/BOUNDARY-LAYER INTERACTIONS Semiannual Progress Report, 1 Jan. - 30 Jun. 1991**
Gary S. Settles 30 Jun. 1991 13 p
(Grant NAG1-1070)
(NASA-CR-188919; NAS 1.26:188919) Avail: NTIS HC/MF A03 CSCL 01A

A database is established on the fluctuating pressure loads produced on aerodynamic surfaces beneath 3-D shock wave/boundary layer interactions. Such loads constitute a fundamental problem of critical concern to future supersonic and hypersonic flight vehicles. A turbulent boundary layer on a flat plate is subjected to interactions with swept planar shock waves generated by sharp fins. Fin angles from 5 to 25 deg at freestream Mach numbers between 2.5 and 4 produce a variety of interaction strengths from weak to very strong. Miniature Kulite pressure transducers mounted in the flat plate were used to measure interaction-induced wall pressure fluctuations. These data will be correlated with proposed new optical data on the fluctuations of the interaction structure, especially that of the lambda-shock system and its associated high-speed jet impingement. Author

**N91-32081#** Federal Aviation Administration, Washington, DC.
**ROTORCRAFT MASTER PLAN**
Nov. 1990 54 p
(AD-A239444) Avail: NTIS HC/MF A04 CSCL 01/3

Total rotorcraft operations are expected to double over the next 20 years, with air taxi and business operations leading early growth, and intercity commuter operations expanding in the later years. To support that growth will require adequate infrastructure, advanced aircraft technology, and an expanding supply of trained pilots. The tiltrotor, a proven new vertical lift technology, may play a significant role in establishing intercity commuter operations. Tiltrotors could operate between heliport facilities called vertiports, which are more elaborate and somewhat larger than today's average heliport. This technology has the potential to enhance National Airspace System (NAS) capacity at a fraction of the otherwise necessary investment in new or improved commercial airports. This vision is based on an overall strategy of positive action by private industry, the FAA, other Federal agencies, and state and local governments to encourage the expansion of rotorcraft operations both in current applications and in scheduled passenger and cargo markets in the 200 to 500 nautical mile range. By 2010, rotorcraft could provide as much as 10 pct. of intercity passenger operations capacity in the NAS. Author

**N91-32082#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
**AERODYNAMICS OF COMBAT AIRCRAFT CONTROLS AND OF GROUND EFFECTS**
G. K. Richey, D. H. Peckham, ed., and J. Leynaert, ed. (Office National d'Etudes et de Recherches Aeronautiques, Paris, France) 1991 22 p
(AGARD-AR-271) Copyright Avail: NTIS HC/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The papers presented at the AGARD Fluid Dynamics Panel Symposium on the aerodynamics of combat aircraft controls and

of ground effects are summarized and evaluated. The reviewer also provides some general conclusions relative to the effectiveness of the symposium in addressing the problems of the aerodynamics of combat aircraft controls and ground effects in an era when a stretched combat maneuverability envelope is needed to enhance both offensive and defensive combat capability. Recommendations for future experimental and computational fluid dynamics activities are also addressed. Author

**N91-32083** Notre Dame Univ., IN.
**COMPRESSIBLE FLOWS WITH VORTICAL DISTURBANCES AROUND A CASCADE OF AIRFOILS Ph.D. Thesis**
Jisheng Fang 1991 222 p
Avail: Univ. Microfilms Order No. DA9122948 CSCL 01A

Numerical solutions were developed for three dimensional, periodic, vortical flows around a cascade of airfoils. The solutions use the approximation of the rapid distortion theory and thus fully account for the effects of distortion of the vortical disturbances as they propagate through the spatially varying mean flow. The numerical scheme is based on the splitting of the unsteady velocity into a vortical part which is a known function in terms of the upstream flow conditions and the Lagrangian coordinates of the mean flow, and a potential part satisfying a nonconstant coefficient, inhomogeneous, convective wave equation. A new downstream out-flow boundary condition is proposed to complete the unsteady boundary value problem. By writing the downstream condition in terms of the unsteady pressure, the difficulties associated with the singular behavior of the unsteady vortical velocity are avoided. This condition is relatively simple and suitable for numerical computations. By using a body-fitted coordinate system, the unsteady potential is computed in the frequency domain. The numerical scheme is validated by comparison with flat plate cascade results. In general, the agreement is very good for reduced frequencies ranging from 0 to 5 and Mach numbers from 0 to 0.8. Dissert. Abstr.

**N91-32084*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**UNSTRUCTURED-GRID METHODS DEVELOPMENT FOR UNSTEADY AERODYNAMIC AND AEROELASTIC ANALYSES**
John T. Batina, Elizabeth M. Lee, William L. Kleb, and Russ D. Rausch Sep. 1991 12 p Presented at the AGARD Structures and Materials Panel Specialists Meeting, San Diego, CA, 6-11 Oct. 1991
(NASA-TM-104143; NAS 1.15:104143) Avail: NTIS HC/MF A03 CSCL 01A

The current status of unstructured grid methods development in the Unsteady Aerodynamics Branch at NASA-Langley is described. These methods are being developed for unsteady aerodynamic and aeroelastic analyses. The flow solvers are highlighted which were developed for the solution of the unsteady Euler equations and selected results are given which show various features of the capability. The results demonstrate 2-D and 3-D applications for both steady and unsteady flows. Comparisons are also made with solutions obtained using a structured grid code and with experimental data to determine the accuracy of the unstructured grid methodology. These comparisons show good agreement which thus verifies the accuracy. Author

**N91-32085*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**AN EXPERIMENTAL INVESTIGATION OF A SUPERSONIC VORTICAL FLOW M.S. Thesis - George Washington Univ.**
Brian S. Levey Sep. 1991 142 p
(NASA-TM-105102; NAS 1.15:105102) Avail: NTIS HC/MF A07 CSCL 01A

Although much research has been done on subsonic vortical flow, the current understanding of these flows remains limited. The effect is characterized of adding swirl to a supersonic jet. The motive is to study the enhancement of supersonic mixing in order to provide more efficient fuel injectors for supersonic combustion (scramjet) engines. The vortical flow was created by tangential injection into a swirl chamber ahead of a converging and/or diverging nozzle. The amount of swirl was varied by changing the number of tangential injection holes and with the removal of the end piece, the jet could be run without swirl. Shadowgraphy, conventional schlieren, and focusing schlieren were used to obtain a qualitative understanding of the jet flow structure. It was determined that an increase in swirl produced an increase in the shear layer growth. Pressure and temperature probes were used to obtain more flow data. The probe data compared favorably with the theoretical calculations, except in the viscous core where viscous effects were not considered negligible. These results verified that a supersonic vortical flow was being created with a maximum helix angle of 33 degs. Author

**N91-32034#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL SIMULATION OF HYPERSONIC FLOW AROUND H-2 ORBITING PLANE**
Yukimitsu Yamamoto, Toshio Akimoto, and Naoyuki Suzuki *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 19-26 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32035#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL CALCULATION OF FLOW FOR SCRAMJET ENGINE**
Tomiko Ishiguro, Satoru Ogawa, and Yasuhiro Wada *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 27-32 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32043#** Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
**FINITE DIFFERENCE NUMERICAL PREDICTION OF AERODYNAMICS FOR AIRFOIL FLYING OVER WAVY WALL**
Kyoko Nitta, Shigenori Ando, and Hiroshi Waku *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 83-89 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32049#** Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
**SUPERSONIC INLET FLOW COMPUTATIONS WITH CAVITY**
Shinichi Kuroda and Kozo Fujii (Tokyo Univ., Japan ) *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 127-132 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32050#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL SIMULATION ANALYSIS OF SIDEWALL EFFECTS IN TWO-DIMENSIONAL WIND TUNNELS**
Junichi Miyakawa, Miho Shimizu, Susumu Takanashi, and Kanichi Amano (Japan Aircraft Development Corp., Tokyo.) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 133-140 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32051#** Institute of Computational Fluid Dynamics, Tokyo (Japan).
**THE THREE DIMENSIONAL NAVIER-STOKES SIMULATIONS OF FLOW OVER A WING WITHOUT ANY TURBULENT MODELLING**
Takuya Sakuragi, Katuya Isii, and Kunio Kuwahara (Tokyo Univ., Japan ) *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 141-146 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32065#** National Aerospace Lab., Tokyo (Japan).
**ANALYSIS OF THE AERODYNAMIC PERFORMANCE OF COUNTER-ROTATING PROPELLER BY MEANS OF VORTEX LATTICE METHOD**
Shigeru Saito and Yasuhiro Mizobuchi (Tokyo Univ., Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 227-232 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32066#** National Aerospace Lab., Tokyo (Japan).
**NAVIER-STOKES ANALYSIS FOR FLOWFIELD AROUND HOVERING ROTOR**
Takashi Aoyama, Keiji Kawachi, and Shigeru Saito *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 233-238 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

# 03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

**N91-32086#** EMA, Mansfield, TX.
**ANALYSIS OF ROTORWASH EFFECTS IN HELICOPTER MISHAPS Final Report**
Samuel W. Ferguson May 1991 59 p Prepared in cooperation with Systems Control Technology, Inc., Arlington, VA
(Contract DTFA01-87-C-00014)
(DOT/FAA/RD-90/17; SCT-91RR-13) Avail: NTIS HC/MF A04

A selected number of rotorwash related helicopter mishaps were reviewed and analyzed. This analysis attempts to determine threshold levels of rotorwash velocity that result in potential hazards. Due to a lack of detailed mishap information being available, critical threshold values of velocity could not be conclusively identified. However, critical ranges of combined rotorwash and ambient wind velocity were identified for several types of investigated mishaps. These ranges of peak velocity generally occur between approximately 30 and 40 knots. Recommendations are provided for improvement of the rotorwash mishap reporting system and for the acquisition of experimentally obtained data which will significantly aid any future rotorwash related mishap analysis efforts. Author

**N91-32087#** National Transportation Safety Board, Washington, DC.
**AIRCRAFT ACCIDENT REPORT: AVIANCA, THE AIRLINE OF COLUMBIA, BOEING 707-321B, HK 2016, FUEL EXHAUSTION, COVE NECK, NEW YORK, JANUARY 25, 1990**
30 Apr. 1991 292 p
(PB91-910404; NTSB/AAR-91/04) Avail: NTIS HC/MF A13; paper copy also avail. on Standing Order, deposit account required (minimum deposit $100 US, Canada, and Mexico; all others $200). Single copies also avail. in paper copy or microfiche CSCL 01C

The crash of an Avianca Airlines Boeing 707-321B in Cove Neck, Long Island, New York on 25 Jan. 1990 is explained. The safety issues discussed are pilot responsibilities regarding planning, fuel requirements, and flight following during international flights; pilot-to-controller communications; air traffic control flow control procedures; and flightcrew coordination and English language proficiency of foreign crews. Recommendations concerning these issues were addressed to the FAA and the Department Administrativo de Aeronautico Civil (DAAC), Columbia. Author

**N91-32088*#** Environmental Research Inst. of Michigan, Ann Arbor.
**SYNTHETIC APERTURE RADAR IMAGERY OF AIRPORTS AND SURROUNDING AREAS: STUDY OF CLUTTER AT GRAZING ANGLES AND THEIR POLARIMETRIC PROPERTIES Final Report, 31 Aug. 1987 - 30 Dec. 1990**
Robert G. Onstott, Denise J. Gineris, and James T. Clinthorne Washington NASA Oct. 1991 200 p
(Contract NAS1-18465)
(NASA-CR-4398; NAS 1.26:4398; DOT/FAA/RD-91/14) Avail: NTIS HC/MF A09 CSCL 09E

The statistical description of ground clutter at an airport and in the surrounding area is addressed. These data are being utilized in a program to detect microbursts. Synthetic aperture radar data were collected at the Denver Stapleton Airport. Mountain terrain data were examined to determine if they may potentially contribute to range ambiguity problems and degrade microburst detection. Results suggest that mountain clutter may not present a special problem source. The examination of clutter at small grazing angles was continued by examining data collected at especially low altitudes. Cultural objects such as buildings produce strong sources of backscatter at angles of about 85 deg, with responses of 30 dB to 60 dB above the background. Otherwise there are a few sources which produce significant scatter. The polarization properties of hydrospheres and clutter were examined with the intent of determining the optimum polarization. This polarization was determined to be dependent upon the ratio of VV and HH polarizations of both rain and ground clutter. Author

**N91-32089#** Sandia National Labs., Albuquerque, NM.
**INTERIM EXPLOSIVES DETECTION ALTERNATIVES**
R. P. Syler 1991 6 p Presented at the 32nd Institute of Nuclear Materials Management (INMM) Annual Meeting, New Orleans, LA, 28-31 Jul. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016188; SAND-91-1391C; CONF-910774-58) Avail: NTIS HC/MF A02

There is a general concern with insiders smuggling bomb-quantities of explosives into sensitive facilities. At this time, there is no single explosives detection device that is suitable for monitoring personnel and their packages for explosives in an operational facility environment. However, there are techniques combining available commercial technologies with procedures and threat analysis that can significantly increase the insiders risk and reduce the population of adversaries. This paper describes the available applicable explosives detection technologies and discusses the techniques that could be implemented on an interim basis. It is important that these techniques be considered, so that some interim level of security against the explosives threat can be established until more sophisticated equipment that is under development becomes available. DOE

**N91-32600*#** National Severe Storms Lab., Norman, OK.
**LIGHTNING THREAT TO AIRCRAFT: DO WE KNOW ALL WE NEED TO KNOW?**
Vladislav Mazur *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 8 p (For primary document see N91-32599 24-47)
Avail: NTiS HC/MF A99 CSCL 01C

**N91-32601*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**DESCRIPTION AND INTERPRETATION OF AIRCRAFT LIGHTNING ATTACHMENT ELECTRIC AND MAGNETIC FIELD MEASUREMENTS AND VIDEO OBSERVATION**
J. P. Moreau and S. Larigaldie *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32602*#** National Severe Storms Lab., Norman, OK.
**INTRACLOUD DEVELOPMENT OF LIGHTNING STRIKES TO AIRCRAFT**
Vladislav Mazur *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
(Contract DTFA03-87-A-00021)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32611*#** Raychem Ltd., Swindon (England).
**THE PERFORMANCE OF CABLE BRAIDS AND TERMINATIONS TO LIGHTNING INDUCED TRANSIENTS**
David Crofts *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32612*#** Fokker Space and Systems, Amsterdam (Netherlands).
**LIGHTNING PROTECTION OF THE FOKKER 100 CFRP RUDDER**
A. J. M. Ruiter *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32613*#** Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.).
**PROTECTION OF ELECTRICAL AND ELECTRONIC EQUIPMENT AGAINST LIGHTNING INDIRECT EFFECTS ON THE AIRBUS A340 WING**
Olaf Spiller *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32625*#** New Mexico Inst. of Mining and Technology, Socorro. Lab. for Atmospheric Research.
**CHARGE CONTROL EXPERIMENTS ON A CH-53E HELICOPTER IN A DUSTY ENVIRONMENT**
C. B. Moore, J. J. Jones, and S. J. Hunyady *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32626*#** Naval Air Test Center, Patuxent River, MD. Electromagnetic Pulse Section.
**RESULTS OF THE RECENT PRECIPITATION STATIC FLIGHT TEST PROGRAM ON THE NAVY P-3B ANTISUBMARINE AIRCRAFT**
Mike Whitaker *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 7 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32631*#** Centre d'Essais Aeronautique Toulouse (France).
**INFLUENCE OF CONFIGURATION EFFECTS ON MULTIPLE BURST SIMULATION TESTING**
J. L. Emanuely and M. Cantaloube *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32637*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**FD-TD CALCULATION WITH COMPOSITE MATERIALS. APPLICATION TO C160 AIRCRAFT MEASUREMENTS**
J. C. Alliot, J. Grando, F. Issac, and X. Ferrieres (SLX Informatique, Courbevoie, France ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32641*#** Atlantic Research Corp., Arlington, VA. Professional Services Group.
**AN ASSESSMENT OF TAILORING OF LIGHTNING PROTECTION DESIGN REQUIREMENTS FOR A COMPOSITE WING STRUCTURE ON A METALLIC AIRCRAFT**
T. L. Harwood *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 12 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32642*#** United Kingdom Atomic Energy Authority, Abingdon (England).
**LIGHTNING PROTECTION DESIGN AND TESTING OF AN ALL COMPOSITE WET WING FOR THE EGRETT**
B. J. C. Burrows, S. J. Haigh, C. Chessum, and V. P. Dunkley *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p Sponsored in part by Grob Aircraft Co., Mindelheim, Fed. Republic of Germany (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32648*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**FD-TD NUMERICAL SIMULATION OF AN ENTIRE LIGHTNING STRIKE ON THE C160 AIRCRAFT**
J. C. Alliot, J. Grando, J. D. Muller, and X. Ferrieres (SLX Informatique, Courbevoie, France ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p Previously announced in IAA as A91-45619 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32650*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**APPLICATION OF SURFACE ELECTRICAL DISCHARGES TO THE STUDY OF LIGHTNING STRIKES ON AIRCRAFT**
J. L. Boulay and S. Larigaldie *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced in IAA as A91-45612 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

**N91-32651*#** SRI International Corp., Menlo Park, CA.
**SCALE-MODEL CHARGE-TRANSFER TECHNIQUE FOR MEASURING ENHANCEMENT FACTORS**
J. Kositsky and J. E. Nanevicz *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
(Contract F04701-90-C-0023)
Avail: NTIS HC/MF A99 CSCL 01C

# 04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

**N91-32090#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany, F.R.). Abt. Luft- und Raumfahrtpsychologie.
**STUDY OF THE PREDICTIVE VALIDITY OF A PSYCHOLOGICAL SELECTION PROCEDURE FOR AIR-TRAFFIC CONTROLLERS BASED ON TRAINING CRITERIA**
Hinnerk Eissfeldt and Peter Maschke Jan. 1991 58 p In GERMAN; ENGLISH summary
(DLR-FB-91-11; ISSN-0939-2963; ETN-91-90042) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 23 DM

Predictive validities of a psychological aptitude test battery for applicants for the Air Traffic Control (ATC) occupation were determined on the criteria of training success. Of 2174 applicants, tested over the period from 1982 through 1985, 201 started training. One hundred sixty five of them (82 percent) finished the three year traning with success. Univariate as well as multivariate analyses resulted in acceptable validity coefficients. Results of theoretical based parts of training were better predictable than those related to more practical elements of ATC training. This might be due to a reduced reliability of the criteria of practical training. ESA

**N91-32091#** Department of Transportation, Cambridge, MA.
**FEDERAL RADIONAVIGATION PLAN, 1990 Final Report, Jan. 1988 - Dec. 1990**
1990 182 p Prepared in cooperation with Department of Transportation, Washington, DC and Department of Defense, Washington, DC
(PB91-190868; DOT-VNTSC-RSPA-90-3; DOD-4650.4) Avail: NTIS HC/MF A09 CSCL 17G

The Federal Radionavigation Plan (FRP) delineates policies and plans for radionavigation services provided by the U.S. Government to ensure efficient use of resources and full protection of national interests. The FRP sets forth the Federal interagency approach to the implementation and operation of radionavigation systems. The FRP is updated biennially. The sixth edition describes respective areas of authority and responsibility, and provides a management structure by which the individual operating agencies will define and meet requirements in a cost-effective manner. The current policy on the radionavigation systems mix is also included. The constantly changing radionavigation user profile and rapid advancements in systems technology, combined with delays in the U.S. space program, require that the FRP remains as dynamic as the issues it addresses. The edition of the FRP builds on the foundation laid by previous editions, and further develops national plans towards providing an optimum mix of radionavigation systems for the foreseeable future. Author

**N91-32092#** Federal Aviation Administration, Atlantic City, NJ.
**RESULTS OF MLS/ILS COMPARISON FLIGHT TEST AT THE YUMA MCAS, ARIZONA Technical Report, Jun. 1990**
Clifford W. Mackin Jul. 1991 21 p
(NASA Order T-0604L)
(DOT/FAA/CT-TN91/10) Avail: NTIS HC/MF A03

A series of flight tests were performed by the FAA Technical Center at the Marine Corps Air Station (MCAS) to obtain Microwave Landing System (MLS) performance data and to compare the performance of a commissioned Category 1 Instrument Landing System (ILS) with the performance of a prototype MLS. The Technical Center's test bed MLS was transported to and collocated with the commissioned Category 1 ILS on runway 21R and MLS met Category 1 standards, the MLS represented a noticeable improvement in accuracy, signal quality, and flyability. Author

**N91-32093#** Federal Aviation Administration, Atlantic City, NJ.
**THE FIRST ANNUAL INTERNATIONAL SATELLITE SURVEILLANCE AND COMMUNICATION SYMPOSIUM**
1991 441 p Symposium held in Atlantic City, NJ, 24-26 Sep. 1991
(DOT/FAA/RD-91/21) Avail: NTIS HC/MF A19

An overview of international programs and developments related to Automatic Dependent Surveillance (ADS)/ Satellite Communications (SATCOM) is provided. Discussions on engineering trials, international coordination activities, development of standards, and user programs are presented. The focus is on the benefits of the FAA ADS/SATCOM Programs for the aviation community. The purpose is to provide information on current ADS/SATCOM developments by government and industry of participating countries and to project the future activities required for successful implementation of the ADS/SATCOM programs. For individual titles, see N91-32094 through N91-32128.

**N91-32094#** Aerospace Engineering and Research Associates, Inc., Landover, MD.
**AUTOMATIC DEPENDENT SURVEILLANCE (ADS) PROGRAM SUMMARY**
Lonnie H. Bowlin, Guy T. Germana, and Peter L. Massoglia (Federal Aviation Administration, Washington, DC.) *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 30-39 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The system architecture and components of a satellite data link based oceanic Air Traffic Control (ATC) System are discussed. Topics such as the role of the Aeronautical Telecommunications Network, the status of avionics development, and the International Civil Aviation Organization's (ICAO's) Automatic Dependent Surveillance (ADS) Panel efforts are addressed from an ATC perspective. Author

**N91-32095#** Federal Aviation Administration, Washington, DC.
**SATELLITE COMMUNICATIONS (SATCOM) Project Summary**
Joseph F. Dorfler *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 42-47 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The Federal Aviation Administration (FAA) Satellite Program consists of two complimentary activities: the Satellite Communications (SATCOM) Project and the Satellite Navigation (SATNAV) Project. The objectives of this program are twofold: to determine the capabilities of satellites for civil aviation, and to verify, test, and demonstrate applications of satellites, including Automatic Dependent Surveillance (ADS), within the National Airspace System (NAS). This paper introduces and overviews the SATCOM Project. The specific objectives of the SATCOM Project are to enhance the efficiency of Air Traffic Management (ATM) in oceanic airspace first and in the NAS later, and to enhance the efficiency of air carrier operations. To exploit satellite communication for maximum benefit of both the FAA and the Aviation community, the SATCOM Project is divided into three complimentary activities whose objectives are as follows: (1) to guide the development, test, and validation of national and international standards for the establishment and certification of the Aeronautical Mobile Satellite Safety (Route) Service (AMS(R)S); (2) to select and test, in cooperation with the aviation community, several satellite communications applications in key areas in order to demonstrate the substantial benefits gained by their implementation; and (3) to extend the benefits of satellite communications to general aviation through a study of the potential for future widespread use of satellite communications in the NAS considering the prospects of availability of new and innovative technologies and approaches to affect the desired benefits.
Author

**N91-32096#** International Civil Aviation Organization, Montreal (Quebec).
**INTERNATIONAL STANDARDIZATION OF FUTURE AIR NAVIGATION SYSTEMS AUTOMATIC DEPENDENT SURVEILLANCE (ADS) ICAO ADS PANEL ACTIVITIES**
Francisco Castro-Rodriguez *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 49-55 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

To ensure safety, regularity, and efficiency of international civil aviation operations, international standardization is essential in all matters concerning the operation of aircraft and the facilities and services required such as aerodromes, telecommunications, navigation aids, meteorology, air traffic services, search and rescue, aeronautical information services, and aeronautical charts. Participation in this process of standardization by all countries is absolutely necessary. The International Civil Aviation Organization (ICAO) Council adopts (or amends when necessary) international standards and recommended practices and approves procedures for the safety, regularity, and efficiency of air navigation. The ICAO is actively involved in the evolutionary development of the Air Navigation System and in global implementation planning for the communications, navigation, and surveillance systems (CNS). Automatic dependent surveillance (ADS) is the key to improvements in air traffic management on a world-wide basis, and its development and implementation is being guided by ICAO through the Future Air Navigation (FANS) Committee (Phase 2) and panels of the Air Navigation Commission. Some of the topics covered include: (1) the role and function of the ICAO; (2) technical work and standardization; (3) regional planning and implementation; (4) future CNS systems; (5) ADS; (6) air traffic control automated systems based on ADS; (7) FANS-phase 2; and (8) related ICAO technical bodies. Author

**N91-32097#** Federal Aviation Administration, Washington, DC. International Procedures Branch.
**INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) AUTOMATIC DEPENDENT SURVEILLANCE PANEL (ADSP) ACTIVITIES**
W. Frank Price and Faye I. Francy (MiTech, Inc., Washington, DC.) *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 57-64 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Automatic Dependent Surveillance (ADS), with the Air Traffic Control (ATC) Automation Data Link, has the potential to upgrade the efficiency and safety of ATC over much of the world's airspace. The system must be standardized to the extent that hardware and message formats are compatible, regardless of which satellite is being used. This maximizes the potential usefulness of the system and provides the motivation for international aircraft operators to equip their fleets with necessary avionics. But if only a few countries were to adopt the system, its potential usefulness would be reduced correspondingly. Some of the topics covered include: (1) the International Civil Aviation Organization (ICAO) ADS Panel's (ADSP's) terms of reference, work program, meeting agenda, and activities; (2) a definition of ADS; (3) operational requirements for ADS; (4) the effect of ADS on separation; (5) ADS-ATC communications procedures; (6) operational communication requirement; and (7) operational requirements for two-way pilot-controller communications for the effective use of ADS. Author

**N91-32098#** Federal Aviation Administration, Washington, DC.
**INTERNATIONAL PROGRAM SUMMARY**
Peter L. Massoglia and William J. Budurka (MiTech, Inc., Washington, DC.) *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 67-85 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The Automatic Dependent Surveillance (ADS) Programs of those countries which, in addition to the U.S., are most heavily involved in the operational implementation of ADS on an international basis are identified and described. The past and on-going International Civil Aviation Organization (ICAO) supported ADS activities that provide the overall guidelines for the individual country ADS Programs are also identified and described. Author

**N91-32099#** Federal Aviation Administration, Atlantic City, NJ.
**AUTOMATIC DEPENDENT SURVEILLANCE PACIFIC ENGINEERING TRIALS**
Frank L. Lorge *In its* The First Annual International Satellite Surveillance and Communication Symposium 1991 p 95-100 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

In 1988, the FAA initiated a cooperative program, called the Pacific Engineering Trials (PET), to evaluate the operational use of Automatic Dependent Surveillance (ADS) and the data link used to support it. The PET incorporates available equipment into a functional ADS prototype for the evaluation of the operational aspects of ADS. This program eases the transition from the current, manual system, to the fully automatic system of the future. Results will be used in developing the specifications for ADS components, and identifying operational and technical issues which must be resolved before the ADS System can become fully functional. These issues will be addressed in the development stage to ensure that the fielded system meets all operational requirements in an efficient manner. The PET Program is still in its early stages, but results are already being applied to the development of ADS and data link. The PET is one part of the overall FAA implementation strategy to improve the efficiency of oceanic air traffic control (ATC) The first step, certification of the avionics and limited use of the data link for sending ATC messages, is nearing completion. The PET are helping smooth the transition to the oceanic system of the future. This transition has already begun, resulting in changes to the way oceanic ATC is performed. This in turn provides benefits in terms of airspace and operational efficiency while maintaining the excellent safety record of oceanic air travel. Some of the topics covered include: (1) participants; (2) equipment; (3) FAA aircraft; and (4) data analysis. Author

**N91-32100#** Ministry of Transportation, Tokyo (Japan). Radio Engineering Div.
**ADS (AUTOMATIC DEPENDENT SURVEILLANCE) PET (PACIFIC ENGINEERING TRIAL) PROGRAM IN JAPAN**
Hiroki Takeda *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 103-109 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Australia, the U.S., and Japan have agreed to initiate a cooperative Automatic Dependent Surveillance (ADS) Pacific Engineering Trial (PET) Program. The participating agencies are the Austrailian Civil Aviation Authority (CAA), the U.S. FAA, and the Japan Civil Aviation Bureau (JCAB). The commercial airlines such as Quantas, United, Northwest, and Japan Airlines are going to participate in this ADS PET Program. Although the international standard for the Aeronautical Mobile Satellite Service (AMSS) and the ADS has not been finalized by the International Civil Aviation Organization (ICAO) yet, this ADS PET Program is expected to provide the opportunities concerning pre-operational experiences as well as various technical expertise for the development of these standards. The goals of this ADS PET Program are to resolve technical issues to gain operational experiences and to identify key issues related to the use of ADS. Some of the topics covered include: (1) system configuration; (2) data acquisition flow; (3) data analysis method; and (4) the program schedule. Author

**N91-32101#** Civil Aviation Authority, Canberra (Australia).
**AUSTRALIAN EXPERIMENTS IN AUTOMATIC DEPENDENT SURVEILLANCE (ADS) INCLUDING THE PACIFIC ENGINEERING TRIALS (PET)**
H. Brian OKeeffe and Graeme Challinor *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 111-115 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Japan, Australia, and the U.S. have agreed to a cooperative Automatic Dependent Surveillance (ADS) Trilateral Pacific Engineering Trials (PET) Test Program. The participating agencies are the Australian Civil Aviation Authority (CAA), the Japanese Civil Aviation Bureau (JCAB), and the U.S. Federal Aviation Administration (FAA). National carriers of the three countries are also involved. Two meetings were held to devise and agree on details of the test program. The ADS data are being received in Australia from some transpacific flights and exchanged between the agencies. Increasing amounts of data are expected as more aircraft with ADS capability are placed in service. Australia is also receiving ADS data from two domestic carriers via very high frequency (VHF) ACARS. The development of a general purpose display system is continuing. The displays can be driven by flight plans/pilot position reports, ADS data, or radar data. Prototypes are being placed in air traffic control (ATC) centers for evaluation. Some of the topics covered include: (1) the objectives of the ADS program; (2) the current status of the Australian Domestic Program; (3) the current status of the PET; and (4) future PET cooperation. Author

**N91-32102#** Air Navigation Technical Service, Paris (France). Advanced Systems Div.
**FRENCH SATCOM PROGRAM AND RELATED INTERNATIONAL ACTIVITIES**
Pascal Senard and Patrice Gauthier *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 119-124 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The work is described that the French Administration wishes to undertake, or is currently performing, in the field of satellite communications used for ATC purposes. The aim of this work program is to prepare the possible integration of a future Satcom-based ATC system, in consistency with the needs specific to the French Civil Aviation and in harmony with the approach adopted at an international level. The context is presented in which French ATC authorities have to deal with the emerging concept of satellite communications. A general presentation of the intended work program and of its successive steps is also included. Author

**N91-32103#** Aeronautical Radio, Inc., Annapolis, MD.
**DIGITIZED VOICE TRIALS**
Teresa A. Anderson *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 127-131 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

ARINC (Aeronautical Radio, Inc.) has the voice network architecture in place to support satellite voice communications today. By utilizing existing facilities and procedures, ARINC is able to facilitate rapid implementation of this new technology without adverse impact on system users. ARINC is working closely with the FAA to coordinate the oceanic communication evolution towards direct pilot-controller communications, whether by data or voice. The Digitized Voice Trials will evaluate ATC communication capabilities, define edge of satellite coverage and validate the performance of long duration calls. ARINC supports these efforts by providing the communication service, both in the satellite link and in the establishment of calls. ARINC also provides quality evaluation and assists in data collection. Author

**N91-32104#** Transport Canada Aviation, Ottawa (Ontario). Technical Services.
**AUTOMATIC DEPENDENT SURVEILLANCE (ADS) DEVELOPMENT IN CANADA**
Norman F. Dimock and Donald F. MacLean *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 133-140 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Canadian work in progress to investigate operational and technical requirements for using ADS and data link in ATC is presented. Ongoing tests and experiments are described. North Atlantic ADS trials preparations are reported and some operational and technical issues are discussed. ADS-ATC Simulation plans are outlined. The notable features of ADS Development System workstations, to be used by controllers participating in ADS trials and simulations, are detailed. Author

**N91-32105#** Rockwell International Corp., Cedar Rapids, IA.
**ADS COMMUNICATIONS: A CORNERSTONE**
George A. Cobley *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 143-148 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

ADS Communications forms a cornerstone to the applications and communications networks of the 21st century. The need to communicate operational data between an aircraft and the Air Traffic Services is becoming focused and will lead to ever increasing applications. The obvious ones are the clearances and acknowledgements for oceanic operations, and the natural extension to domestic operations. A brief review of the development is presented, and the trial results are examined. Data are presented on the operational parameters that were collected at the Santa Paula Ground Earth Stations operated by COMSAT. It is shown that the operational signal parameters are statistically comparable to the early predictions. Author

**N91-32106#** Societe International de Telecommunications Aeronautiques, London (England).
**AERONAUTICAL MOBILE SATELLITE SERVICES ESA-PRODAT/SITA AIRCOM SERVICE TRIALS PROGRAMME**
Graham C. Lake, A. Jongejans, and P. Nguyen (European Space Agency, Paris, France ) *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 151-163 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

In order to enhance its existing VHF AIRCOM service and in view of the potential development of satellite-based data communication services, SITA initiated plans for demonstrations and service trials of an Aeronautical Mobile Satellite Communications system for the benefit of its member airlines. For this purpose the ESA, INMARSAT, and SITA reached an agreement to carry out service trials using the existing MARECS satellite and based upon the development of the ESA PRODAT project. The PRODAT/AIRCOM Service Trials launched in late 1986 were successful and were expected to be completed by July 1991. The experimental work carried out by all involved participants is described briefly. Author

**N91-32107#** Computer Technology Associates, Inc., McKee City, NJ.
**AERONAUTICAL MOBILE SATELLITE SERVICE (AMSS) MESSAGE AND VOICE ACCESS REQUEST TRANSIT DELAY**
Thomas F. Dehel *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 181-190 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The development of standards for the use of satellite communications in aviation is supported by FAA. A preliminary analysis and simulation of the Aeronautical Mobile Satellite Service (AMSS) were conducted to determine message transit delay of the system under a range of conditions. The conditions include various message lengths, channel loading, channel data rates, and bit error rates. The simulations focused on the link level and physical levels; the effect of upper layer protocols were not considered as part of this initial effort. The simulation programs ADSSIM and SATSIM were provided which were used to generate results under a range of conditions. The distribution of the results is presented. Author

**N91-32108#** Ministry of Transportation, Tokyo (Japan). Radio Engineering Div.
**SATELLITE DATA LINK RESEARCH AND DEVELOPMENT PROGRAM IN JAPAN**

Hiroki Takeda *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 193-201 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

In parallel with the Automatic Dependent Surveillance (ADS) Pacific Engineering Trail (PET) program which was initiated by Australia, U.S., and Japan, the research and development (R&D) program Satellite Data Link was promoted in Japan. Apart from ADS PET program, the Aircraft Earth Station (AES) and the Ground Earth Station (GES) to be used in this satellite data link R&D program are designed to be fully compatible with the ICAO AMSS Draft SARPs and INMARSAT SDM (System Definition Manual). The main purpose of this R&D program is to validate the bit oriented AMSS system based on the OSI (Open Systems Interconnection) model which is now under development in ICAO AMSSP (Aeronautical Mobile Satellite Service Panel). Author

**N91-32109#** ST Systems Corp., Lanham, MD.
**SYSTEM IMPROVEMENTS IDENTIFIED BY THE NORTH ATLANTIC SYSTEMS PLANNING GROUP (NAT/SPG) AS RELATED TO THE CAPABILITIES OF THE OCEANIC DISPLAY AND PLANNING SYSTEM (ODAPS)**
Dan H. Iredell, Rajan Srirangarajan, and John H. Crimmins, Jr. *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 221-230 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The main objective is to relate the current and projected capabilities of ODAPS to a set of the most demanding requirements included in the NAT/SPG system concept description. The following subject areas are covered: controller-pilot communications, position report processing, conflict prediction, and man-computer interfaces. Each of these subject areas are assessed relative to three environments: (1) non-ODAPS (i.e., the manual procedural environment that is currently dominant throughout the world); (2) ODAPS; and (3) ADS/data link (i.e., enhancements to ODAPS). Author

**N91-32110#** International Maritime Satellite Organization, London (England). Aeronautical Services Div.
**INMARSAT ACCESS APPROVAL**
Johnny Nemes *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 241-244 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The INMARSAT Access Approval Process is described that each new SATCOM installation type (i.e., Aircraft Earth Station - AES) must go through. The understanding of the INMARSAT approval process will help avionics and antenna manufacturers to plan the future activities required for timely and successful implementation of the ADS/SATCOM program. The objectives and details of the INMARSAT approval process and the testing required are described, including information on the entity that has the responsibility for leading the approval, the AES Integrator. A brief description is presented of the commissioning tests that will be carried out on each example of an AES installation, of an access approved type, before entering service. Author

**N91-32111#** Communications Satellite Corp., Washington, DC. Aeronautical Services.
**OPERATIONAL SATCOM: MOVING FROM TRIALS TO SERVICE**
David W. Lipke and Elizabeth Young *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 247-251 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The INTELSAT system offers the capability for a network that could link area control centers (ACCs) and a host Inmarsat aeronautical ground earth station (GES). INTELSAT's Intelnet service can provide international data communication between a large INTELSAT station and microterminals at ACC locations. Concerning ocean air traffic management: the era of aeronautical satellite communications is opening with a rapid take-up by the corporate aviation community. The number of aircraft now equipped for voice service is growing steadily and greatly exceeds the number that have data capability. Satellites and ground earth stations to assist in the provision of improved ocean Air Traffic Control are in place and procedures for using the satellite network for delivering messages are well understood. Consideration should be given to supplementing terrestrial GES-ACC interconnect with a satellite broadcast mode type of signal for the dissemination of ADS reports to multiple ACC's. Author

**N91-32112#** Aeronautical Radio, Inc., Washington, DC. Civil Aviation Services.
**THE FAA/ARINC INITIAL IMPLEMENTATION OF AMSS**
Angus D. McEachen, III *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 253-266 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The application of satellite based Communication Navigation and Surveillance (CNS) as defined by ICAO will provide significant cost benefits to the global air transport industry. The evolution is traced of Aeronautical Mobile Satellite Service (AMSS), the primary applications that are now targeted for use of AMSS are identified, and the series of phases of worldwide system transition from the current analog voice service to the future digital satellite communication service are described. Key implementation events that should take place for orderly transition to the future AMSS are also identified. A brief description of the current status of various trials and demonstrations of AMSS applications are also described. The improvements in Air Traffic Management (ATM) through the application of digital satellite based communication links offers the most cost efficient means to increase the quality and level of services offered and improve safety of operations while simultaneously lowering the overall system wide costs. Author

**N91-32113#** Societe International de Telecommunications Aeronautiques, London (England).
**SITA SATELLITE AIR COMMUNICATIONS IMPLEMENTATION**
Graham C. Lake *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 269-274 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Societe Internationale de Telecommunications Aeronautiques (SITA) is introduced as a global aeronautical communications service provider. SITA operates the world's largest private telecommunications network, serving over 400 airlines in 190 countries. SITA provides VHF data link services in some 45 countries and a world wide voice and data Aeronautical Mobile Satellite Service (AMSS). The status and evolution of SITA AMSS is discussed, together with a review of Air Traffic Control use of SITA data link facilities. Author

**N91-32114#** Honeywell, Inc., Phoenix, AZ.
**ADS INTEGRATION INTO THE FLIGHT MANAGEMENT COMPUTER**
Ingeborg L. Ray *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 277-280 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The Aeronautical Telecommunications Network (ATN) Project is providing the aeronautical community with the first test environment for end-to-end bit-oriented communications. As a part of this project, current plans are for the Flight Management Computer (FMC) to provide the first avionics bit-oriented Automatic Dependent Surveillance (ADS) application process for the basic set of ADS messages. The FMS will use the necessary services of OSI communications protocols to support this first step of the FAA's Air Traffic Services (ATS) program. As more advanced steps of Air Traffic Services evolve, the navigational capabilities inherent in the FMS will allow for an optimal host environment. The initial role of the flight management function in Step One of the ADS

services development is discussed along with the future capabilities of the FMC as avionics host for the expanding Air Traffic Management environment. Author

**N91-32115#** Stanford Telecommunications, Inc., Washington, DC.
**USE OF ISO PROTOCOLS IN THE ADS ENVIRONMENT**
Stephen P. VanTrees *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 283-292 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The International Organization for Standardization (ISO) protocols are presented which are currently used and envisioned for Automatic Dependent Surveillance (ADS) communications support. The Open Systems Interconnection (OSI) seven layer model as used in ADS is presented. The network layer protocols ISO 8473, ISO 9542, and ISO CD 10747 are presented. The transport layer protocol ISO 8073 is presented. THe application layer protocols ISO 8650 and ISO 9072 are presented for information purposes. The benefit of ISO protocols in terms of interoperability and portability is important to the ADS program. THe selection, profiling, implementation and fielding of these protocols is an important ongoing effort. Author

**N91-32116#** Federal Aviation Administration, Washington, DC.
**NEAR-TERM SATELLITE-BASED OCEANIC AIR TRAFFIC CONTROL: GROUND SYSTEM DESCRIPTION**
Elbert J. Henry and Mary A. McClarnon-Minnix (Mitre Corp., McLean, VA.) *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 299-308 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

A functional description is presented of the next generation of U.S. oceanic air traffic control ground automation system. The system will be based on the use of automatic dependent surveillance and data link communications between pilot and controller. A number of automation features will be provided to the controllers to take advantage of the surveillance and communications capabilities. The significant aspects are described of the surveillance, communications, and automation capabilities, and how the air traffic controller will operate in the new environment is illustrated. In addition, some background is given on the work of the FAA's Oceanic System Requirements Team of active oceanic controllers. Author

**N91-32117#** Mitre Corp., McLean, VA.
**IMPACT OF AUTOMATION AND DATA LINK ENHANCEMENTS ON OCEANIC AIR TRAFFIC CONTROL**
Sabrina F. Saunders-Hodge and Mark H. Runnels *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 311-319 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Among other anticipated benefits, the implementation of Automatic Dependent Surveillance (ADS) is expected to facilitate significant improvements in the overall efficiency of oceanic air traffic control (ATC). The findings are presented of an analysis conducted to evaluate the potential impact of ADS on current oceanic ATC operations and procedures. Author

**N91-32118#** Federal Aviation Administration, Washington, DC.
**US OCEANIC AIR TRAFFIC CONTROL: PAST, PRESENT, AND FUTURE**
Amado Colberg *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 323-325 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

A brief review is presented of oceanic air traffic control as it has been conducted in the U.S. The system improvements are described which are planned through the use of satellite communications technology, including air-ground data link and Automatic Dependent Surveillance (ADS). As nearly all of the oceanic airspace is outside of air traffic control (ATC) radar coverage, the oceanic ATC system has been characterized by the use of procedural nonradar separation. Further, most of the oceanic airspace is beyond the coverage of land based VHF communications, which is subject to line of sight limitations. Accordingly, it has been necessary to use High Frequency for air/ground/air communications. HF communications are relayed through commercial facilities dedicated to this purpose, which results in an additional delay in the ultimate reception of air traffic control messages. It is anticipated that the use of satellite relays will provide reliable and direct data link communications between controllers and pilots, eliminating the present communication delays. The use of ADS will provide continuous surveillance of oceanic air traffic on displays similar in appearance to ATC radar displays. Author

**N91-32119#** Mitre Corp., McLean, VA.
**PRELIMINARY EVALUATION OF ADS/RADAR CORRELATION**
Christopher N. Andrews and Leonard A. Wojcik *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 327-334 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The potential utility, limitations, and implementation factors are addressed which are associated with the use of an Automatic Dependent Surveillance (ADS)/radar correlation function in an operational ADS system. The quality is also evaluated of surveillance data that could be obtained from ADS equipped flights and its suitability is assessed for oceanic automation by comparing engineering trials ADS data to radar data. Author

**N91-32120#** International Business Machines Corp., Gaithersburg, MD.
**COOPERATIVE ADS/AAS INTEGRATION**
Charles A. Kengla and Sherman G. Francisco *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 337-347 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Automatic Dependent Surveillance (ADS) offers the aviation community major new capabilities for serving air traffic in oceanic areas and other remote regions. For that potential to be fully realized, it is essential that the Federal Aviation Administration (FAA) Advanced Automation System (AAS) be fully integrated with ADS so that Air Traffic Control (ATC) services and communications based on ADS may be provided in a way similar to that now used in the radar environment. An overview of the AAS is presented. A suggested approach to providing an ADS interface with AAS is described, based on extending an existing AAS interface gateway module design while retaining the base distributed system concepts and standards. Author

**N91-32121#** Federal Aviation Administration, Atlantic City, NJ. Flight Test Branch.
**OPERATIONAL OCEANIC AIR TRAFFIC CONTROL USING SATELLITE DATA LINK: INITIAL IMPLEMENTATION**
Donald Armstrong *In its* The First Annual International Satellite Surveillance and Communication Symposium 1991 p 349-352 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The objective is the development of a phased transition plan for air traffic control (ATC) to utilize satellite data links and voice communication to service oceanic flights. Details of the transition plan implementation, data collection, and data reduction and analysis are discussed. The first satellite communication based data link messages were exchanged in September, 1990. This trail demonstrated automatic and pilot entered messages and ground based uplink capabilities. Author

**N91-32122#** Federal Aviation Administration, Washington, DC. Research and Development Service.
**FLIGHT OPERATIONS AND AIR TRAFFIC MANAGEMENT INTEGRATION**
Clyde A. Miller and George C. Chang *In* FAA, The First Annual

International Satellite Surveillance and Communication Symposium 1991 p 357-363 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Flight management systems are installed in many air carrier and business aviation aircraft for the purpose of assisting the flight crew in assuring a safe and efficient flight trajectory in accordance with the cleared flight plan. Recently the Federal Aviation Administration (FAA) launched a comprehensive research and development project focused on the use of air-ground data links for integrating the operation of airborne flight management automation. Integrated operation of flight management and air traffic management (ATM) automation appears to offer benefits for airspace users and ATM service providers. Author

**N91-32123#** IAT, Menlo Park, CA
**AUTOMATIC DEPENDENT SURVEILLANCE BENEFIT AND COST ANALYSIS: INTERIM STUDY RESULTS**
George J. Couluris *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 371-375 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The results of an interim study of the economic and operational impacts of automatic dependent surveillance (ADS) are discussed. ADS will make provisions for satellite communications and advanced air traffic control (ATC) automation and will enhance air traffic services in oceanic and other airspaces. ADS will provide direct communication between pilots and air traffic controllers and enhanced ATC flight monitoring and airspace management capabilities. The benefit and cost study identified the operational benefits and implementation requirements of ADS and analyzed their potential impacts on users and providers of air traffic services. Potential safety benefits were qualitatively assessed, and potential cost savings due to ADS operations and implementation costs were quantitatively estimated. The study examined implementation and potential operational impacts for the North Atlantic and Pacific oceanic areas through the year 2010. The resulting estimated cost savings due to ADS exceed the estimated implementation costs. Author

**N91-32124#** Air Transport Association of America, Washington, DC.
**SATELLITE SURVEILLANCE AND COMMUNICATIONS AIRLINE BENEFITS: THE TELEPHONE MYTH**
Paul R. Ryan *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 379-383 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Given here is American Airlines' perspective on the requirements and benefits of installing satellite communications and Automatic Dependent Surveillance (ADS). Also discussed is the airline's approach to the satellite public telephone and flight safety issues. Their economic analysis suggests that the systems are cost justified. Author

**N91-32125#** Boeing Commercial Airplane Co., Seattle, WA. Flight Management Systems and Data Links.
**COMMUNICATIONS NEEDS OF THE FUTURE AIR-GROUND INTERFACE**
Anthony J. Martin and N. D. Molloy *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 385-406 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The successful evolution of air ground data link applications is dependent on international cooperation and agreements to establish the environment to provide economic returns to participating airlines and meet the safety requirements of the future air traffic control environment. The Boeing perspective on the future requirements for air/ground data links is given, with emphasis on the near term uses of SATCOM satellite communications. The current status of SATCOM systems on the 747-400 airplane is described together with the development efforts that are underway to achieve oceanic air traffic control via SATCOM data links by 1993. The design approach being taken for the new Boeing 777 airplane is also discussed. Author

**N91-32126#** Computer Technology Associates, Inc., McKee City, NJ.
**A MODEL HUMAN ENGINEERING APPROACH TO THE DEVELOPMENT OF REGULATORY STANDARDS FOR DIGITAL COMMUNICATION TECHNOLOGIES: DEFINING SAFETY FROM A HUMAN-MACHINE SYSTEMS PERSPECTIVE**
Renate Roske-Hofstrand, Jack Berkowitz, and Albert Rehmann (Federal Aviation Administration, Atlantic City, NJ.) *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 409-418 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Outlined here is the initiation of a comprehensive research program that will investigate the integration of digital communications into the flightdeck and will address specific safety considerations. A basic research scheme, some preliminary results, and future directions are discussed. Results of the authors' Aviation Safety Reporting System (ASRS) data analysis indicate some typical human factors problems within the flightdeck. For example, pilots committed many omission errors during classically busy phases of flight, and these errors involved data entry into the flight management system (FMS) and other flightdeck systems. It is reasonable to expect that similar errors will occur in conjunction with a data link subsystem. In addition, the integration of the subsystem into the overall system may alter the procedural and operational human-machine and human-human relations in the cockpit. The role of the Federal Aviation Administration's airborne data link human factors effort is to provide inputs to certification. Through the decomposition and analysis of the flightdeck, recommendations can be formulated about proper integration practices. Included in these recommendations will be inputs about hardware/software design, sub-system integration, intra-cockpit procedures, and pilot-air traffic control integration procedures. Author

**N91-32127#** Mitre Corp., McLean, VA. Center for Advanced Aviation System Development.
**GROUND AUTOMATION PROCESSING OF NEAR-TERM OCEANIC ATC DATA LINK MESSAGES**
Yueh-Shiou Wu *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 433-442 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

Effective use of data links requires computer aided message creation and processing to alleviate the additional workload associated with data entry for both pilots and controllers. Described here is how ground automation will process pre-defined fixed format oceanic data link messages in the near-term time frame. A message set consisting of message categories, message subcategories, and message types is proposed. Required characteristics for this message set are discussed. One downlink required message is traced as it goes through the various steps of ground automation processing and eventually becomes an air traffic control clearance message delivered to the pilot. Author

**N91-32128#** Aeronautical Radio, Inc., Washington, DC. Advanced Satellite Systems Engineering.
**EVALUATION OF OCEANIC FLIGHT DECK WORKLOAD AND ERROR REDUCTIONS THROUGH THE USE OF DATA COMMUNICATIONS**
Virginia White and Richard E. Heinrich *In* FAA, The First Annual International Satellite Surveillance and Communication Symposium 1991 p 445-452 (For primary document see N91-32093 24-04)
Avail: NTIS HC/MF A19

The use of oceanic data communications provides increased efficiencies to the flight deck for airline operation center/air traffic control (AOC/ATC) communications. Through the use of automated and semi-automated systems supported by data links, the flight

deck can achieve both workload and error reduction. Furthermore, the data link can provide oceanic areas with improved error detection and tracking capabilities that can drastically improve the current system. Author

**N91-32129** Deutsche Geodaetische Kommission, Munich (Germany, F.R.).
**EXAMINATIONS OF THE RATIONAL UTILIZATION OF THE GLOBAL POSITIONING SYSTEM (GPS) IN LOCAL NETWORKS Ph.D. Thesis - Technische Hochschule [UNTERSUCHUNGEN ZUM RATIONELLEN EINSATZ DER GPS IN KLEINRAEUMIGEN NETZEN]**
Hans-Juergen Euler 1990 124 p In GERMAN
(Ser-C-361; ISBN-3-7696-9409-0; ISSN-0065-5325; ETN-91-90013) Copyright Avail: Deutsche Geodaetische Kommission, Bayerischen Akademie der Wissenschaften, Marstallplatz 8, D-8000 Munich 22, Fed. Republic of Germany

It is shown that the accuracy of the satellite signal received, plays an important part for the optimization of the observations times. Technical details limiting the accuracy of the satellite signal are discussed. The influence of phase center eccentricities is shown. Multipath propagation problems are described. A method using kinematic static measurement for the determination of the observation times is presented. Its utilization in simulation compensation leads to a representation of the efficiency of kinematic static measurement with single frequency receivers. A method is given for the determination of the ambiguities in reduced observation time for two frequency receivers. ESA

# 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation*.

**N91-32130#** Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
**ON THE MAXIMUM RANGE OF FLYING WINGS Final Report**
Peter J. Torvik 1 Sep. 1990 21 p
(AD-A229487; AFIT/EN-TR-90-07) Avail: NTIS HC/MF A03 CSCL 01/3

The classical equations for determining the maximum range of aircraft with propeller and jet propulsion systems are reviewed, along with previous work conducted to determine the optimal division of aircraft volume between fuselage and wing components. That the jet powered flying wing configuration produces optimal range only for limited geometries is confirmed. The optimal range of aircraft employing high bypass jet engines is explored, and found to lead to a broader range of design parameters for which the flying wing design produces maximum range than is the case when a pure jet system is used. GRA

**N91-32131#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Triebwerkssysteme.
**FLIGHT MECHANICAL MODEL FOR PERFORMANCE CALCULATIONS AND INTERACTIONS BETWEEN FLIGHT VEHICLE AND RAMJET IN REGARD TO THE FLIGHT ORBIT**
Frans G. J. Kremer Feb. 1991 95 p In GERMAN; ENGLISH summary Report will also be announced as translation ESA-TT-1267
(DLR-FB-91-03; ISSN-0939-2963; ETN-91-90039; ESA-TT-1267) Avail: NTIS HC/MF A05; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 35.50 DM

Performance calculations for a ramjet first require determination of the thrust at each point of the flight orbit. This is done by means of a flight mechanical model. The flight mechanical model builds on the law of equilibrium of forces. Furthermore an aerodynamic model for the flight vehicle is used. The flight orbit is calculated given the flight profile, acceleration in flight direction and curving acceleration. The interactions between the flight vehicle and the ramjet in close regard to the flight orbit are addressed. The parameters which influence the fuel consumption in regard to mission aspects are described. The role of the angle of attack and the significance of the design are closely examined. The interactions are described by means of variation of parameters (being the dynamic head, acceleration in flight direction and the curving acceleration). ESA

**N91-32132*#** Boeing Co., Seattle, WA.
**AN EXAMPLE OF REQUIREMENTS FOR ADVANCED SUBSONIC CIVIL TRANSPORT (ASCT) FLIGHT CONTROL SYSTEM USING STRUCTURED TECHNIQUES Interim Report**
Robert E. McLees and Gerald C. Cohen Oct. 1991 273 p
(Contract NAS1-18586)
(NASA-CR-187526; NAS 1.26:187526) Avail: NTIS HC/MF A12 CSCL 01C

The requirements are presented for an Advanced Subsonic Civil Transport (ASCT) flight control system generated using structured techniques. The requirements definition starts from initially performing a mission analysis to identify the high level control system requirements and functions necessary to satisfy the mission flight. The result of the study is an example set of control system requirements partially represented using a derivative of Yourdon's structured techniques. Also provided is a research focus for studying structured design methodologies and in particular design-for-validation philosophies. Author

**N91-32133#** National Center for Atmospheric Research, Boulder, CO. Atmospheric Technology Div.
**UNCERTAINTY ANALYSIS OF A RADOME FLUSH ORIFICE AIR MOTION SYSTEM FOR THE MEASUREMENT OF AIRCRAFT INCIDENT ANGLES**
Edward N. Brown Mar. 1991 35 p
(PB91-198176; NCAR/TN-359+STR) Avail: NTIS HC/MF A03 CSCL 01C

An assessment of the uncertainties, or maximum expected error, in the measurement of the relative wind angles is patterned after the published works including Abernethy (1973) and the International Standards Organization (1978). Separate appendices detail the analysis and elemental errors of aircraft static and dynamic pressures, the radome sensitivity coefficients, the differential pressures corresponding to the wind angles, the wind angles, and true airspeed. The results enable: (1) calculation of the accuracy of parameters to be derived from the uncertainties; and (2) some control over the sources of error to achieve a required level of accuracy. The analysis deals with the subsonic speed range and is limited to incident angle range of +/- 10 degrees. GRA

**N91-32134*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**AEROELASTIC LOADS AND STABILITY INVESTIGATION OF A FULL-SCALE HINGELESS ROTOR**
Randall L. Peterson and Wayne Johnson (Johnson Aeronautics, Palo Alto, CA.) Jul. 1991 11 p Presented at DGLR/AAAF/AIAA/RAeS International Forum on Aeroelasticity and Structural Dynamics, Aachen, Fed. Republic of Germany, 3-6 Jun. 1991
(NASA-TM-103867; A-91157; NAS 1.15:103867) Avail: NTIS HC/MF A03 CSCL 01C

An analytical investigation was conducted to study the influence of various parameters on predicting the aeroelastic loads and stability of a full-scale hingeless rotor in hover and forward flight. The CAMRAD/JA (Comprehensive Analytical Model of Rotorcraft Aerodynamics and Dynamics, Johnson Aeronautics) analysis code is used to obtain the analytical predictions. Data are presented for rotor blade bending and torsional moments as well as inplane damping data obtained for rotor operation in hover at a constant rotor rotational speed of 425 rpm and thrust coefficients between 0.0 and 0.12. Experimental data are presented from a test in the wind tunnel. Validation of the rotor system structural model with

experimental rotor blade loads data shows excellent correlation with analytical results. Using this analysis, the influence of different aerodynamic inflow models, the number of generalized blade and body degrees of freedom, and the control-system stiffness at predicted stability levels are shown. Forward flight predictions of the BO-105 rotor system for 1-G thrust conditions at advance ratios of 0.0 to 0.35 are presented. The influence of different aerodynamic inflow models, dynamic inflow models and shaft angle variations on predicted stability levels are shown as a function of advance ratio. Author

**N91-32045#** National Aerospace Lab., Tokyo (Japan).
**AERODYNAMIC DESIGN OF NON-PLANAR WING BY INVERSE METHOD WITH NAVIER-STOKES EQUATION**
Takashi Kaiden, Jun Ogino (Mitsubishi Heavy-Industries Ltd., Tokyo, Japan ), and Susumu Takanashi *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 103-107 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32046#** National Aerospace Lab., Tokyo (Japan).
**NAVIER-STOKES SIMULATION FOR COMPLETE AIRCRAFT CONFIGURATION**
Susumu Takanashi and Keisuke Sawada (Kawasaki Heavy Industries Ltd., Kagamihara, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 109-113 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32047#** Fuji Heavy Industries Ltd., Utsunomiya (Japan).
**BLENDED WING-BODY CONFIGURATION DESIGN USING TRANSONIC INVERSE CODE**
Yosuhiro Tani, Yasuhiro Koshioka, and Hidehiro Hirose *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 115-120 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

# 06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

**N91-32135*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**HUMAN-CENTERED AIRCRAFT AUTOMATION: A CONCEPT AND GUIDELINES**
Charles E. Billings Aug. 1991 119 p
(NASA-TM-103885; A-91192; NAS 1.15:103885) Avail: NTIS HC/MF A06 CSCL 01D

Aircraft automation is examined and its effects on flight crews. Generic guidelines are proposed for the design and use of automation in transport aircraft, in the hope of stimulating increased and more effective dialogue among designers of automated cockpits, purchasers of automated aircraft, and the pilots who must fly those aircraft in line operations. The goal is to explore the means whereby automation may be a maximally effective tool or resource for pilots without compromising human authority and with an increase in system safety. After definition of the domain of the aircraft pilot and brief discussion of the history of aircraft automation, a concept of human centered automation is presented and discussed. Automated devices are categorized as a control automation, information automation, and management automation. The environment and context of aircraft automation are then considered, followed by thoughts on the likely future of automation of that category. Author

# 07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

**N91-32136#** Wyoming Univ., Laramie.
**REVIEW OF AIR FORCE COMPRESSOR BLADE AND VANE REWORK AND IT'S IMPACT ON PERFORMANCE AND COSTS**
Robert A. Wheasler May 1990 60 p
(AD-A229518; WRDC-TM-90-203-POTX) Avail: NTIS HC/MF A04 CSCL 01/3

The first successful powered flight of an aircraft was a direct result of the development of an engine to propel the aircraft. Since that time engineers have been faced with challenges to develop improved propulsive devices. Although the basic principles of the gas turbine engine are understood, its operation seems oversimplified to some. The problems involved in developing a high-performance engine include applications of nearly every engineering discipline. The development of the gas turbine engine to its present stage is a result of the vast amount of research that has taken place during the past fifty years, as was the case in the development of the propeller-reciprocating engine. The demands for a high-performance engine have resulted in a high sophisticated design which can only be successful through utilization of all the latest technologies. GRA

**N91-32137#** Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
**COST EFFECTIVENESS OF TWO VERSUS THREE LEVELS OF MAINTENANCE FOR TURBINE ENGINES IN THE AIR FORCE INVENTORY M.S. Thesis**
John T. Schiefen Sep. 1990 100 p
(AD-A229622; AFIT/GLM/RQ/90S-49) Avail: NTIS HC/MF A05 CSCL 21/5

This study examined the life cycle costs (LCC) for Air Force turbine engines. Specifically, the research compared the costs for two, three, and modified three level maintenance concepts. To achieve the research objectives, a LCC model, the Super Operating and Support Cost Model (SOSCM), was used. SOSCM is used by the Propulsion SPO, ASD/YZ, at Wright Patterson AFB to estimate costs for Air Force engines. A sensitivity analysis was run on a generic test case to determine the effect of changes in certain cost drivers on LCC. There were a few important findings. First, for this case, the LCC for the two level concept was 14.7 pct. greater than the cost for three levels of maintenance. Two factors accounted for most of the difference. The number of spare engines required increased, the second destination transportation costs rose sharply. The study also showed that changes in some factors have a greater impact on the costs for two levels of maintenance than three. Overall, the research points out that it should not be assumed that moving to two levels of maintenance will lower costs. Engine types should be considered individually to determine the most cost effective maintenance concept. GRA

**N91-32138*#** Detroit Diesel Allison, Indianapolis, IN.
**INVESTIGATION OF ADVANCED COUNTERROTATION BLADE CONFIGURATION CONCEPTS FOR HIGH SPEED TURBOPROP SYSTEMS. TASK 3: ADVANCED FAN SECTION GRID GENERATOR FINAL REPORT AND COMPUTER PROGRAM USER'S MANUAL Final Report, Feb. - Jun. 1991**
Andrew J. Crook and Robert A. Delaney Sep. 1991 111 p
Original contains color illustrations
(Contract NAS3-25270)
(NASA-CR-187129; NAS 1.26:187129) Avail: NTIS HC/MF A06; 3 functional color pages CSCL 21E

A procedure is studied for generating three-dimensional grids for advanced turbofan engine fan section geometries. The procedure constructs a discrete mesh about engine sections

containing the fan stage, an arbitrary number of axisymmetric radial flow splitters, a booster stage, and a bifurcated core/bypass flow duct with guide vanes. The mesh is an h-type grid system, the points being distributed with a transfinite interpolation scheme with axial and radial spacing being user specified. Elliptic smoothing of the grid in the meridional plane is a post-process option. The grid generation scheme is consistent with aerodynamic analyses utilizing the average-passage equation system developed by Dr. John Adamczyk of NASA Lewis. This flow solution scheme requires a series of blade specific grids each having a common axisymmetric mesh, but varying in the circumferential direction according to the geometry of the specific blade row. Author

**N91-32139#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Triebwerkssysteme.
**THERMODYNAMIC FLOW DESCRIPTION OF A RAMJET FOR DETERMINATION OF ENGINE FORCES AND MOMENTS**
Frans G. J. Kremer Jan. 1991 155 p In GERMAN; ENGLISH summary Report will also be announced as translation ESA-TT-1266
(DLR-FB-91-02; ISSN-0939-2963; ETN-91-90038; ESA-TT-1266)
Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 55.50 DM

A theoretical calculation model for a ramjet is described. This model serves for performance calculations for a supersonic flight vehicle. These performance calculations require determination of the forces and moments of the ramjet. The engine forces and moments are determined from the flow conditions of the engine. Therefore the flow conditions are determined at characteristic planes. The used suppositions and assumptions are described in detail. It is important to define which forces are engine and which forces are flight vehicle specific. This is called bookkeeping. Furthermore the order of magnitude of several parameters is given. Variation of these parameters, performed by means of a computer program, gives insight into the connexion and the mutual interactions. ESA

**N91-32140*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
**PRELIMINARY FLIGHT EVALUATION OF AN ENGINE PERFORMANCE OPTIMIZATION ALGORITHM**
H. H. Lambert, G. B. Gilyard, J. D. Chisholm, and L. J. Kerr (Pratt and Whitney Aircraft, West Palm Beach, FL.) Washington Oct. 1991 19 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-26 Jun. 1991; cosponsored by AIAA, ASME, SAE, ASEE Previously announced in IAA as A91-44089
(NASA-TM-4328; H-1745; NAS 1.15:4328) Avail: NTIS HC/MF A03 CSCL 21E

A performance seeking control (PSC) algorithm has undergone initial flight test evaluation in subsonic operation of a PW 1128 engined F-15. This algorithm is designed to optimize the quasi-steady performance of an engine for three primary modes: (1) minimum fuel consumption; (2) minimum fan turbine inlet temperature (FTIT); and (3) maximum thrust. The flight test results have verified a thrust specific fuel consumption reduction of 1 pct., up to 100 R decreases in FTIT, and increases of as much as 12 pct. in maximum thrust. PSC technology promises to be of value in next generation tactical and transport aircraft. Author

**N91-32141*#** Gordon (Sanford), Cleveland, OH.
**THE NAVY/NASA ENGINE PROGRAM (NNEP89): INTERFACING THE PROGRAM FOR THE CALCULATION OF COMPLEX CHEMICAL EQUILIBRIUM COMPOSITIONS (CEC) Final Report**
Sanford Gordon Sep. 1991 24 p Prepared in cooperation with Sverdrup Technology, Inc., Brook Park, OH
(Contract NAS3-24105)
(NASA-CR-187208; NAS 1.26:187208) Avail: NTIS HC/MF A03 CSCL 21E

The NNEP is a general computer program for calculating aircraft engine performance. NNEP has been used extensively to calculate the design and off-design (matched) performance of a broad range of turbine engines, ranging from subsonic turboprops to variable cycle engines for supersonic transports. Recently, however, there has been increased interest in applications for which NNEP is not capable of simulating, such as the use of alternate fuels including cryogenic fuels and the inclusion of chemical dissociation effects at high temperatures. To overcome these limitations, NNEP was extended by including a general chemical equilibrium method. This permits consideration of any propellant system and the calculation of performance with dissociation effects. The new extended program is referred to as NNEP89. Author

**N91-32717*#** Lightning Technologies, Inc., Pittsfield, MA.
**DESIGN OF LIGHTNING PROTECTION FOR A FULL-AUTHORITY DIGITAL ENGINE CONTROL**
M. Dargi, E. Rupke, and K. Wiles *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lighnting and Static Electricity, Volume 2 Aug. 1991 12 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 21E

**N91-32718*#** Lightning Technologies, Inc., Pittsfield, MA.
**CERTIFICATION OF LIGHTNING PROTECTION FOR A FULL-AUTHORITY DIGITAL ENGINE CONTROL**
M. Dargi, E. Rupke, and K. Wiles *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 21E

# 08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

**N91-32142#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abt. Stabilitaet und Antwort.
**AEROELASTIC FLUTTER PREVENTION IN GLIDERS AND SMALL AIRCRAFT**
Walter Stender and Fritz Kiessling Sep. 1990 64 p
(DLR-Mitt-91-03; ISSN-0176-7739; ETN-91-90031) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 15 DM

An empirical method which can be used by the manufacturers of gliders and small aircraft to evaluate flutter vulnerability without extensive computational analysis and to take appropriate preventive measures is specified. Suggestions on how designers can avert flutter from the very outset of the design process are given. This method was applied in numerous cases and can be considered proven for conventional structures. It is based on the results of a simple vibration test as well as stiffness and friction measurements taken on the control system. Statistically derived design frequencies are given, thus restricting the number of vibration modes which must be considered. Through this method the required mass balance for the control surfaces is derived. Simple formulas for the calculation of the torsion frequency and the critical speed for torsional flutter are given. ESA

**N91-32143*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**APPLICATION OF AN INTEGRATED FLIGHT/PROPULSION CONTROL DESIGN METHODOLOGY TO A STOVL AIRCRAFT**
Sanjay Garg and Duane L. Mattern (Sverdrup Technology, Inc., Brook Park, OH.) 1991 12 p Presented at the Guidance, Navigation and Control Conference, New Orleans, LA, 12-14 Aug. 1991; sponsored by AIAA Previously announced in IAA as A91-49793

(NASA-TM-105254; E-6583; NAS 1.15:105254; AIAA-91-2792) Avail: NTIS HC/MF A03 CSCL 01C

Results are presented from the application of an emerging Integrated Flight/Propulsion Control (IFPC) design methodology to a Short Take Off and Vertical Landing (STOVL) aircraft in transition flight. The steps in the methodology consist of designing command shaping prefilters to provide the overall desired response to pilot command inputs. A previously designed centralized controller is first validated for the integrated airframe/engine plant used. This integrated plant is derived from a different model of the engine subsystem than the one used for the centralized controller design. The centralized controller is then partitioned in a decentralized, hierarchical structure comprising of airframe lateral and longitudinal subcontrollers and an engine subcontroller. Command shaping prefilters from the pilot control effector inputs are then designed and time histories of the closed loop IFPC system response to simulated pilot commands are compared to desired responses based on handling qualities requirements. Finally, the propulsion system safety and nonlinear limited protection logic is wrapped around the engine subcontroller and the response of the closed loop integrated system is evaluated for transients that encounter the propulsion surge margin limit. Author

**N91-32144** California Univ., Los Angeles.
**CONTROL DESIGN VARIABLE LINKING FOR OPTIMIZATION OF STRUCTURAL/CONTROL SYSTEMS Ph.D. Thesis**
Ik-Min Jin 1991 151 p
Avail: Univ. Microfilms Order No. DA9122667

A method is presented to integrate the design space of structural/control system optimization problems in the case of linear state feedback control. Conventional structural sizing variables and elements of the feedback gain matrix are both treated as strictly independent design variables in the optimization by extending design variable linking concepts to the control gains. Several approximation concepts, including new control design variable linking schemes are used to formulate the integrated structural/control optimization problem into the general nonlinear mathematical programming problem. Examples which involve a variety of behavioral constraints, including constraints on static deflections, dynamic stability, control effort, peak transient displacement, acceleration and control force limits, are effectively solved by using the method presented here. Dissert. Abstr.

**N91-32145*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**DEVELOPMENT AND EVALUATION OF AN INVERSE SOLUTION TECHNIQUE FOR STUDYING HELICOPTER MANEUVERABILITY AND AGILITY**
Matthew S. Whalley Jul. 1991 55 p
(NASA-TM-102889; A-91020; NAS 1.15:102889; USAAVSCOM-TR-90-A-008) Avail: NTIS HC/MF A04 CSCL 01C

An inverse solution technique for determining the maximum maneuvering performance of a helicopter using smooth, pilotlike control inputs is presented. Also described is a pilot simulation experiment performed to investigate the accuracy of the solution resulting from this technique. The maneuverability and agility capability of the helicopter math model was varied by varying the pitch and roll damping, the maximum pitch and roll rate, and the maximum load-factor capability. Three maneuvers were investigated: a 180-deg turn, a longitudinal pop-up, and a lateral jink. The inverse solution technique yielded accurate predictions of pilot-in-the-loop maneuvering performance for two of the three maneuvers. Author

**N91-32146#** Aeronautical Research Labs., Melbourne (Australia).
**TIME-FREQUENCY DOMAIN ANALYSIS OF HELICOPTER TRANSMISSION VIBRATION**
B. D. Forrester Aug. 1991 37 p Original contains color illustrations
(ARL-PROP-R-180; AR-005-606) Copyright Avail: NTIS HC/MF A03

Vibration analysis is playing an increasingly important role in the early detection of helicopter transmission faults. Current vibration analysis techniques used in helicopter transmission fault detection require selective filtering or manipulation of the signal, based on assumptions about the nature of the signal. In some cases these techniques can give misleading results. It is shown that the application of time-frequency domain representations, based on the Wigner-Ville distribution, is capable of detecting a variety of vibration features which can be used to classify faults. Author

# 09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

**N91-32147** National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
**COMPARISON OF FACTORS GIVEN IN ICRU REPORT 23 AND IAEA TRS 277 FOR CONVERTING FROM EXPOSURE/AIR KERMA TO ABSORBED DOSE TO WATER FOR MEDIUM ENERGY X RAYS**
K. E. Rosser Feb. 1991 20 p
(NPL-RSA(EXT)-15; ISSN-0955-9655; ETN-91-99868) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 OLW, England

New values of the factors required to convert the reading of an ionization chamber calibrated in terms of air kerma (or exposure) to absorbed dose to water for medium energy X-rays were given in a code of practice published by the Internatinal Atomic Energy Agency (IAEA) in 1987. The factors differ by a maximum of 12.5 at 0.15 mm Cu half value layer from those given in International Commission of Radiation Units (ICRU) report 23. The difference between the ICRU and IAEA conversion factors are discussed and the basis of the recommendation of the IPSM low and medium energy X-ray dosimetry working party are formed, i.e., that dosimetry in the United Kingdom should be based on ICRU report 23 and therefore on the current HPA code of practice. ESA

**N91-32148#** Norwegian Defence Research Establishment, Kjeller.
**DEVELOPMENT OF PROCEDURES FOR VERIFICATION OF ALLEGED USE OF CHEMICAL WARFARE AGENTS: APPLICATION OF PROCEDURES AFTER A SIMULATED ATTACK ON AN AIR BASE**
John Aa Toernes, Bjoern A. Johnsen, Aase M. Opstad, Per J. Karlsen, and Marita Ljoenes 8 May 1991 47 p
(FFI-91/6006; ISSN-0802-2437; ETN-91-90056) Avail: NTIS HC/MF A03

Work carried out to improve and test the procedures developed for verification of alleged use of chemical warfare agents is summarized. The handling of samples from a simulated attack with chemical weapons on an air base is addressed. A bottle filled with 200 g of the nerve agent simulant dipropyleneglycol momenthylether was exploded near an airfield taxiway. An inspection team previously unaware of the exact site of the explosion was called upon and was able to localize and define the contaminated area within 30 minutes using the chemical agent monitor. Twenty samples were then collected in the area defined and treated according to the Norwegian verification procedure. ESA

**N91-32149*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**NOZZLE DIFFUSER FOR USE WITH AN OPEN TEST SECTION OF A WIND TUNNEL Patent Application**

P. Stephen Barna, inventor (to NASA) (Barna, P. Stephen, Consultant, Norfolk, VA ) 8 Aug. 1991 16 p
(NASA-Case-LAR-14424-1-SB; NAS 1.71:LAR-14424-1-SB; US-Patent-Appl-SN-743468) Avail: NTIS HC/MF A03 CSCL 14B

The nozzle diffuser has an inlet in fluid communication with the narrowed inlet of an open test chamber in a conventional wind tunnel. The nozzle diffuser has a passageway extending from its inlet to an outlet in communication with the open test section. The passageway has an internal cross sectional area which increases from its inlet to its outlet and which may be defined by top and bottom isosceles trapezoid walls of a particular flare angle and by isosceles trapezoid side walls of a different flare angle. In addition, a collector having a decreasing internal cross sectional area from inlet to outlet may be provided at the opposite end of the test chamber such that its outlet is in communication with a diffuser located at this outlet. NASA

**N91-32039#** National Aerospace Lab., Tokyo (Japan).
**RAREFIED GAS NUMERICAL WIND TUNNEL 6: DELTA WING**
Katsuhisa Koura, Emi Kanematsu, and Mikinari Takahira (Daiko Ltd., Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 49-52 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32628*#** Naval Air Test Center, Patuxent River, MD. Electromagnetic Pulse Section.
**ACTIVATION OF THE NAVY'S INDIRECT EFFECTS LIGHTNING SIMULATION LABORATORY**
Mike Whitaker *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 14B

**N91-32633*#** Maxwell Labs., Inc., San Diego, CA.
**A TRANSPORTABLE 50 kA DUAL MODE LIGHTNING SIMULATOR**
K. Salisbury, S. Lloyd, and Y. G. Chen *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 7 p (For primary document see N91-32599 24-47)
(Contract B239503)
Avail: NTIS HC/MF A99 CSCL 14B

**N91-32636*#** Sandia National Labs., Albuquerque, NM.
**THE SANDIA TRANSPORTABLE TRIGGERED LIGHTNING INSTRUMENTATION FACILITY**
George H. Schnetzer and Richard J. Fisher *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p Previously announced as N91-18564 Sponsored in part by Army (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 14B

**N91-32700*#** Centre d'Etudes de Gramat (France).
**A REAL SCALE SIMULATOR FOR HIGH FREQUENCY LEMP**
D. Gauthier and D. Serafin *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 11 p Sponsored in part by Direction des Recherches, Etudes et Techniques (DRET) (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 14B

# 12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

**N91-32150#** Sandia National Labs., Albuquerque, NM.
**POWER SYSTEM REQUIREMENTS AND SELECTION FOR THE SPACE EXPLORATION INITIATIVE**
K. L. Biringer, D. E. Bartine, D. Buden, and J. Foreman (Naval Research Lab., Washington, DC.) 1991 8 p Presented at the AIAA/NASA/OAI Conference on Advanced SEI Technologies, Cleveland, OH, 3-4 Sep. 1991 Previously announced in IAA as A91-52373
(Contract DE-AC04-76DP-00789)
(DE91-016707; SAND-91-1593C; CONF-9109226-6) Avail: NTIS HC/MF A02

The Space Exploration Initiative (SEI) seeks to reestablish a U.S. program of manned and unmanned space exploration. The President has called for a program which includes a space station element, a manned habitation of the moon, and a human exploration of Mars. The NASA Synthesis Group has developed four significantly different architectures for the SEI program. One key element of a space exploration effort is the power required to support the missions. The Power Speciality Team of the Synthesis Group was tasked with assessing and evaluating the power requirements and candidate power technologies for such missions. Inputs to the effort came from existing NASA studies as well as other government agency inputs such as those from DOD and DOE. In addition, there were industry and university briefings and results of solicitations from the AIAA and the general public as part of the NASA outreach effort. Because of the variety of power needs in the SEI program, there will be a need for multiple power system technologies including solar, nuclear and electrochemical. Due to the high rocket masses required to propel payloads to the moon and beyond to Mars, there is great emphasis placed on the need for high power density and high energy density systems. Power system technology development work is needed and results will determine the ultimate technology selections. DOE

**N91-32151#** Lawrence Livermore National Lab., CA.
**SCOUTING THE NEIGHBORHOOD: IN OUR LIFETIME**
L. Wood 2 Jul. 1991 12 p Presented at the Near-Earth Asteroids Conference, San Juan Capistrano, CA, 30 Jun. - 3 Jul. 1991
(Contract W-7405-eng-48)
(DE91-017083; UCRL-JC-107782; CONF-9106266-1) Avail: NTIS HC/MF A03

Objective review of the past decade-and-a-half of planetary and space science generates a surprise-free scenario for the next few decades which features only modest advances in human understanding of the solar system, our immediate neighborhood in the physical universe. The origins of such this scenario are recapitulated to better understand how surprises can be introduced into it in reasonably high-likelihood fashions, and the bases for some such surprises are noted. Representative means by which planetary and space scientists now alive can have a wonderful life after all are sketched. DOE

**N91-32152#** European Space Agency, Paris (France).
**ROSETTA/CNSR: A COMET-NUCLEUS SAMPLE-RETURN MISSION AND SYSTEM DEFINITION DOCUMENT**
Erica Rolfe, ed. and Bruce Battrick, ed. Jun. 1991 182 p Original contains color illustrations
(ESA-SP-1125; ISBN-92-9092-072-6; ISSN-0379-6566; ETN-91-90067) Copyright Avail: NTIS HC/MF A09; ESA, EPD, Noordwijk, Netherlands, HC 50 Dutch guilders

The goal of the Rosetta Comet-Nucleus Sample return mission is to send an unmanned spacecraft to a comet to retrieve cometry material samples and return them to Earth for intensive analysis. Since cometry nuclei are the least evolved solid bodies in the solar system, this work will add to our understanding of the evolution of the solar system. The wide scope and outstanding scientific interest of experimental techniques that will be implemented on volatile and nonvolatile constituents of returned cometry samples

are demonstrated. The scientific instruments and operational requirements as well as the returned sample handling are discussed. The Rosetta mission design is presented and the following are considered: goals, requirements and constraints; mission options and description, spacecraft design and performance; recommendations on follow on activities, development plan, program and management aspects. ESA

# 13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

**N91-32153** Illinois Univ. at Urbana-Champaign, Savoy.
**OPTIMAL COOPERATIVE TIME-FIXED IMPULSIVE RENDEZVOUS Ph.D. Thesis**
Koorosh Mirfakhraie 1991 111 p
Avail: Univ. Microfilms Order No. DA9124462

A method was developed for determining optimal, i.e., minimum fuel, trajectories for the fixed-time cooperative rendezvous of two spacecrafts. The method assumes that the vehicles perform a minimum of three impulsive maneuvers with each vehicle being active, that is, making at least one maneuver. The cost of reference rendezvous solution is improved by an optimizer which uses an analytical gradient developed using primer vector theory and a new solution for the optimal terminal (rendezvous) maneuver. Results are presented for a large number of cases in which the allotted time for rendezvous and other problem parameters including initial relative position, engine efficiencies, initial masses, and fuel mass fractions of two vehicles are varied. Further improvement in cost may be realized when an additional, i.e., mid-course, impulse is allowed as part of one of the vehicles' trajectory. The criteria for addition of a mid-course impulse to a neighboring solution trajectory was developed. The cooperative rendezvous proves advantageous particularly in missions with relatively short durations and when fuel constraints are present. Dissert. Abstr.

**N91-32154** Colorado Univ., Boulder.
**A STUDY OF GEOGRAPHICALLY CORRELATED ORBIT ERRORS FOR TOPEX-INCORPORATING GPS DATA Ph.D. Thesis**
Scott James Mitchell 1990 123 p
Avail: Univ. Microfilms Order No. DA9122364

The orbit determination experiment onboard Topex utilizing GPS will allow dynamic, kinematic, and reduced dynamic approaches to estimation satellite positioning. The overall radial orbit accuracy was evaluated and the geographic correlation of the orbit error was characterized using these techniques. It was determined which of these methods will produce orbits which best fulfill the mission science objectives. A combination was used of consider covariance analysis and simulation with the JPL's Oasis orbit simulation and error analysis program. A method was demonstrated for selecting a subset of the geopotential coefficients consisting of those coefficients which can cause significant unmodelled perturbations of the satellite orbit. The reduced dynamic and kinematic tracking techniques completely remove the geographical correlation of the radial orbit error present with dynamic tracking. Kinematic orbit determination displays large errors due to isolated periods of poor observing geometry. The results of spectral analysis of simulations of the Topex radial orbit error are discussed. Dissert. Abstr.

**N91-32251*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**PRECISE ORBIT DETERMINATION OF HIGH-EARTH ELLIPTICAL ORBITERS USING DIFFERENCED DOPPLER AND RANGE MEASUREMENTS**
J. A. Estefan *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 1-22 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 22A

# 14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

**N91-32627*#** Boeing Aerospace Co., Cocoa Beach, FL.
**LAUNCH PAD LIGHTNING PROTECTION EFFECTIVENESS**
James R. Stahmann *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 12 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 14B

# 15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

**N91-32155*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Interdisciplinary Center for Applied Mathematics.
**OPTIMAL CONTROL PROBLEMS WITH SWITCHING POINTS Ph.D. Thesis, 1990 Final Report**
Hans Seywald Washington NASA Sep. 1991 162 p
(Contract NAG1-946; F49620-87-C-0116)
(NASA-CR-4393; NAS 1.26:4393) Avail: NTIS HC/MF A08 CSCL 22B

An overview is presented of the problems and difficulties that arise in solving optimal control problems with switching points. A brief discussion of existing optimality conditions is given and a numerical approach for solving the multipoint boundary value problems associated with the first-order necessary conditions of optimal control is presented. Two real-life aerospace optimization problems are treated explicitly. These are altitude maximization for a sounding rocket (Goddard Problem) in the presence of a dynamic pressure limit, and range maximization for a supersonic aircraft flying in the vertical, also in the presence of a dynamic pressure limit. In the second problem singular control appears along arcs with active dynamic pressure limit, which in the context of optimal control, represents a first-order state inequality constraint. An extension of the Generalized Legendre-Clebsch Condition to the case of singular control along state/control constrained arcs is presented and is applied to the aircraft range maximization problem stated above. A contribution to the field of Jacobi Necessary Conditions is made by giving a new proof for the non-optimality of conjugate paths in the Accessory Minimum Problem. Because of its simple and explicit character, the new proof may provide the basis for an extension of Jacobi's Necessary Condition to the case of the trajectories with interior point constraints. Finally, the result that touch points cannot occur for first-order state inequality constraints is extended to the case of vector valued control functions. Author

**N91-32156** Georgia Inst. of Tech., Atlanta.
**TIME DOMAIN FINITE ELEMENTS IN OPTIMAL CONTROL WITH APPLICATION TO LAUNCH VEHICLE GUIDANCE Ph.D. Thesis**
Robert Richard Bless, Jr. 1991 226 p
Avail: Univ. Microfilms Order No. DA9124518

A time domain finite element method is developed for optimal control problems. The theory derived is general enough to handle a large class of problems including optimal control problems that are continuous in the states and controls, problems with discontinuities in the states and/or system equations, problems with control inequality constraints, problems with state inequality constraints, or problems involving any combination of the above.

The theory is developed in such a way that no numerical quadrature is necessary regardless of the degree of nonlinearity in the equations. Also, the same shape functions may be used for every problem because all strong boundary conditions are transformed into natural or weak boundary conditions. In addition, the resulting nonlinear algebraic equations are very sparse. Use of sparse matrix solvers allows for the rapid and accurate solution of very difficult optimization problems. The formulation is applied to launch vehicle trajectory optimization problems, and results show that real time optimal guidance is realizable with this method. The control algorithm uses both FORTRAN and a symbolic computation program to solve problems with a minimum of user interaction.
Dissert. Abstr.

# 16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

**N91-32604*#** Rockwell International Corp., Downey, CA. Space Systems Div.
**LIGHTNING CURRENT RATE OF RISE IN THE NEW LIGHTNING FLASH MODEL FOR THE SPACE SHUTTLE PROGRAM**
Nathaniel G. Bankston *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 14 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 22B

# 17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

**N91-32260*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE ADVANCED RECEIVER II TELEMETRY TEST RESULTS AT GOLDSTONE**
R. Sadr, R. Bevan, and S. Hinedi *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 119-131 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09F

# 18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

**N91-32157#** Sandia National Labs., Albuquerque, NM.
**RV STRINGS OF MAXIMUM CURVATURE**
D. G. Hull (Texas Univ., Austin.) and R. M. Zazworsky 1991 14 p Presented at the AAS/AIAA Astrodynamics Conference, Durango, CO, 19-21 Aug. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016708; SAND-91-0116C; AAS-91-445; CONF-9108126-1)
Avail: NTIS HC/MF A03

To design an effective interceptor for a string of reentry vehicles (RV's) released by a post-boost vehicle (PBV), it is necessary to have information about possible geometries of the string when it reaches a given altitude above the target. The geometry of the string, assumed for simplicity to contain three RV's, is determined by the motion of the PBV which is controlled by varying its thrust direction. Of interest in this study is maximizing the curvature of the string, which is represented by the distance of RV sub 2 from the line joining RV sub 1 and RV sub 3 when RV sub 1 reaches the intercept attitude, subject to the constraints that all three RV's must land within 3000 ft distance of the target. The maximum curvature problem is formulated as a parameter optimization problem and solved by a nonlinear programming code known as GRG2. The thrust angles are assumed to be piecewise linear, and a total of 21 parameters is used. The maximum curvature is shown to be approximately 2900 ft. DOE

# 19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

# 20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

**N91-32158*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**ION BEAM SPUTTERING IN ELECTRIC PROPULSION FACILITIES**
James S. Sovey and Michael J. Patterson 1991 15 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; sponsored by AIAA, SAE, ASME, and ASEE Previously announced in IAA as A91-45785
(NASA-TM-105145; E-6420; NAS 1.15:105145; AIAA-91-2117)
Avail: NTIS HC/MF A03 CSCL 21H

Experiments were undertaken to determine sputter yields of potential ion beam target materials, to assess the impact of charge exchange on beam diagnostics in large facilities, and to examine material erosion and deposition after a 957 hr test of a 5 kW-class ion thruster. The xenon ion sputter yield of flexible graphite was lower than other graphite forms especially at high angles of incidence. Ion beam charge exchange effects were found to hamper beam probe current collection diagnostics even at pressures from 0.7 to 1.7 mPa. Estimates of the xenon ion beam envelope were made and predictions of the thickness of sputter deposited coatings in the facility were compared with measurements. Author

**N91-32159#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (Germany, F.R.). Energetics Research Dept.
**COMPARISON OF KINETIC, EQUILIBRIUM, AND FROZEN ROCKET EXPANSION OBTAINED AT DIFFERENT PROPULSIVE PARAMETERS FOR LAUNCHER AND SPACECRAFT ENGINES**
Detlef Manski Feb. 1991 109 p
(DLR-Mitt-91-02; ISSN-0939-298X; ETN-91-90030) Avail: NTIS

HC/MF A06; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 36.50 DM

Kinetic expansion data expressed by the kinetic specific impulses are presented and compared with equilibrium and frozen specific impulses. These specific impulses and other propulsion related data were calculated beforehand and stored in large data files to assist in system analysis of spacecraft and launchers. Kinetic data concerning spacecraft propulsion indicate kinetic losses up to 20, while the kinetic losses for higher thrust levels such as the space shuttle main engine lie in a regime of only 0.1 and therefore could be neglected. The data files are available on request by the author. ESA

**N91-32160#** Brookhaven National Lab., Upton, NY.
**A NUCLEAR THERMAL ROCKET ENGINE DESIGN BASED ON THE PARTICLE BED REACTOR SUITABLE FOR A MARS MISSION**

J. R. Powell, H. Ludewig, S. Mughabghab, O. Lazareth, K. Perkins, E. C. Selcow, and E. Schmidt 1991 8 p Presented at the AIAA/NASA/OAI Conference on Advanced SEI Technologies, Cleveland, OH, 3-4 Sep. 1991
(Contract DE-AC02-76CH-00016)
(DE91-016898; BNL-45740; CONF-9109226-8) Avail: NTIS HC/MF A02

A mission to Mars will be characterized primarily by relatively long run times and the requirement to achieve a high specific impulse and a high thrust/weight ratio. The particle bed reactor (PBR) concept is inherently flexible, in that with minor changes, it can be designed to satisfy many missions. This flexibility results from the fact that most of the reactor operates at modest temperatures and only a very small volume of the core operates at the outlet temperature. In view of the two requirements two types of PBR will be considered in this paper. The first will attempt to maximize the specific impulse, while the second will attempt to maximize the thrust/weight ratio. It can be concluded from this study that the inherent flexibility implicit in the PBR design makes it a logical choice to achieve an optimized compromise between specific impulse and thrust/weight ratio. DOE

**N91-32161*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**THE NASA CRYOGENIC FLUID MANAGEMENT TECHNOLOGY PROGRAM PLAN**

James R. Faddoul and Stanley D. McIntyre (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) Sep. 1991 24 p Presented at the Conference on Advanced Space Exploration Initiative Technologies, Cleveland, OH, 4-6 Sep. 1991; sponsored by AIAA, NASA, and OAI Previously announced in IAA as A91-52436
(NASA-TM-105256; E-6586; NAS 1.15:105256; AIAA-91-3553)
Avail: NTIS HC/MF A03 CSCL 21H

During the past three decades, NASA has been designing and using large quantities of cryogenic fluids for propulsion system propellants, coolants for experiments, and for environmental control systems. As a consequence, an erroneous conclusion has been drawn that the technology exists for using large quantities of cryogens in space for long periods of time. The attempt here is to dispel that myth and to present the technology needs that require development in order to support the NASA programs of the future. A NASA program, developed through the impetus of the Marshall Space Flight Center and the Lewis Research Center and supported by all NASA centers is outlined. The current state of the art is discussed along with specific needs for near future missions. Then, using the Space Exploration Initiative mission set, cost/benefit projections are made for the development of advanced cryogenic fluid management techniques. Earth based and space based test programs are discussed relative to the technology requirements for liquid storage, supply, and transfer for fluid transfer and advanced instrumentation. Author

**N91-32162*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**MPD THRUSTER TECHNOLOGY**

Roger M. Myers, Maris A. Mantenieks, and Michael R. LaPointe (Sverdrup Technology, Inc., Brook Park, OH.) Sep. 1991 36 p Presented at the Conference on Advanced Space Exploration Initiative Technologies, Cleveland OH, 4-6 Sep. 1991; sponsored in part by NASA, AIAA, and OAI
(NASA-TM-105242; E-6569; NAS 1.15:105242; AIAA-91-3568)
Avail: NTIS HC/MF A03 CSCL 21H

MPD (MagnetoPlasmaDynamic) thrusters demonstrated between 2000 and 7000 seconds specific impulse at efficiencies approaching 40 percent, and were operated continuously at power levels over 500 kW. These demonstrated capabilities, combined with the simplicity and robustness of the thruster, make them attractive candidates for application to both unmanned and manned orbit raising, lunar, and planetary missions. To date, however, only a limited number of thruster configurations, propellants, and operating conditions were studied. The present status of MPD research is reviewed, including developments in the measured performance levels and electrode erosion rates. Theoretical studies of the thruster dynamics are also described. Significant progress was made in establishing empirical scaling laws, performance and lifetime limitations and in the development of numerical codes to simulate the flow field and electrode processes. Author

**N91-32163*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**FIBER-OPTIC APPLICATIONS FOR SPACE-BASED ENGINES**

Amy L. Sovie, Douglas P. Bewley, and Marc G. Millis Sep. 1991 9 p Presented at the Conference on Advanced Space Exploration Initiative Technologies, Cleveland, OH, 4-6 Sep. 1991; cosponsored by AIAA, NASA, and OAI Previously announced in IAA as A91-52468
(NASA-TM-105235; E-6560; NAS 1.15:105235; AIAA-91-3602)
Copyright Avail: NTIS HC/MF A02 CSCL 21H

The use of fiber optic technology is discussed with respect to the instrumentation systems for space based rocket engines. Optical fiber technologies are reviewed with specific attention given to the reliability, light weight, small fiber diameter, and operating life of the components in the space environment. An optical system can facilitate the incorporation of an optical health monitoring system, increase the space available for necessary redundancy, and safe high bandwidth communications that are immune to the effects of electromagnetic radiation. Author

**N91-32164*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**MULTIMEGAWATT ELECTRIC PROPULSION SYSTEM DESIGN CONSIDERATIONS**

J. H. Gilland, Roger M. Myers (Sverdrup Technology, Inc., Brook Park, OH.), and Michael J. Patterson Aug. 1991 16 p Presented at the 21st International Electric Propulsion Conference, Orlando, FL, 18-20 Jul. 1990; sponsored in part by AIAA Previously announced in IAA as A90-52566
(NASA-TM-105152; E-6437; NAS 1.15:105152; AIAA-90-2552)
Avail: NTIS HC/MF A03 CSCL 21H

Piloted Mars Mission Requirements of relatively short trip times and low initial mass in Earth orbit as identified by the NASA Space Exploration Initiative, indicate the need for multimegawatt electric propulsion systems. The design considerations and results for two thruster types, the argon ion, and hydrogen magnetoplasmadynamic thrusters, are addressed in terms of configuration, performance, and mass projections. Preliminary estimates of power management and distribution for these systems are given. Some assessment of these systems' performance in a reference Space Exploration Initiative piloted mission are discussed. Research and development requirements of these systems are also described. Author

**N91-32165*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**ORR-SHERBY-DORN CREEP STRENGTHS OF THE REFRACTORY-METAL ALLOYS C-103, ASTAR-811C, W-5Re, AND W-25Re**

Robert E. English 1991 8 p Prepared for presentation at the 9th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 12-16 Jan. 1992; sponsored in part by New Mexico Univ.
(NASA-TM-105228; E-6551; NAS 1.15:105228) Avail: NTIS HC/MF A02 CSCL 21H

Available creep data for the refractory-metal alloys C-103 (Nb/10 percent Hf/1 percent Ti/0.7 percent Zr), ASTAR-811C (Ta/8 percent W/1 percent Re/0.7 percent Hf/0.025 percent C), W-5Re (W/5 percent Re), and W-25Re (W/25 percent Re) were correlated by the Orr-Sherby-Dorn method and extrapolated to 1 percent creep over 10 years. Useful life was specified to be 2 standard estimates of error below the mean surface through the data. Over the temperature range of 1200 to 1800 K, ASTAR-811C was found to be the strongest of these alloys. In particular, ASTAR-811C was found to have at 1800 K the same creep strength as W-25Re at 1420 K. The difference between these results and those of Horak and Booker likely devolves from the comparative lack of long-time data on tungsten alloys. Author

**N91-32166*#** Martin Marietta Aerospace, Denver, CO. Civil Space and Communications.

**CRYOGENIC ORBITAL NITROGEN EXPERIMENT (CONE): PHASE A/B DESIGN STUDY Final Report, Feb. 1990 - Jul. 1991**

William J. Bailey, Stephen P. Weiner, and Douglas H. Beekman Sep. 1991 244 p
(Contract NAS3-25063)
(NASA-CR-187230; NAS 1.26:187230; MCR-91-1333) Avail: NTIS HC/MF A11 CSCL 10B

Subcritical cryogenic fluid management (CFM) has long been recognized as an enabling technology for future space missions. Subcritical liquid storage and supply are two of the five CFM technology areas that need to be studied in the low gravity on-orbit environment. The Cryogenic Orbital Nitrogen Experiment (CONE) is a LN2 cryogenic storage and supply system demonstration placed in orbit by the National Space Transportation System (NSTS) Orbiter and operated as an in-bay payload. In-space demonstration of CFM using LN2 with a few well defined areas of focus would provide the confidence level required to implement subcritical cryogen use and is the first step towards the more far reaching issue of cryogen transfer and tankage resupply. A conceptual approach for CONE was developed and an overview of the program is described including the following: (1) a description of the background and scope of the technology objectives; (2) a description of the payload design and operation; and (3) the justification for CONE relating to potential near term benefits and risk mitigation for future systems. Data and criteria is provided to correlate in-space performance with analytical and numerical modeling of CFM systems. Author

**N91-32167*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**SPECTROSCOPIC WEAR DETECTOR Patent Application**

George C. Madzsar, inventor (to NASA) 27 Jun. 1991 12 p
(NASA-Case-LEW-15200-1; NAS 1.71:LEW-15200-1; US-Patent-Appl-SN-722446) Avail: NTIS HC/MF A03 CSCL 21H

The elemental composition of a material exposed to hot gases and subjected to wear is determined. Atoms of an elemental species not appearing in this material are implanted in a surface at a depth based on the maximum allowable wear. The exhaust gases are spectroscopically monitored to determine the exposure of these atoms when the maximum allowable wear is reached. NASA

**N91-32168#** Pacific Northwest Lab., Richland, WA.

**PERFORMANCE ENHANCEMENT USING POWER BEAMING FOR ELECTRIC PROPULSION EARTH ORBITAL TRANSPORTERS**

J. E. Dagle Aug. 1991 6 p Presented at the 26th Intersociety Energy Conversion Engineering (IECE) Conference, Boston, MA, 3-9 Aug. 1991
(Contract DE-AC06-76RL-01830)
(DE91-017287; PNL-SA-18894; CONF-910801-18) Avail: NTIS HC/MF A02

An electric propulsion Earth orbital transport vehicle (EOTV) can effectively deliver large payloads using much less propellant than chemical transfer methods. By using an EOTV instead of a chemical upper stage, either a smaller launch vehicle can be used for the same satellite mass or larger satellite can be deployed using the same launch vehicle. However, the propellant mass savings from using the higher specific impulse of electric propulsion may not be enough to overcome the disadvantage of the added mass and cost of the electric propulsion power source. Power system limitations have been a major factor delaying the acceptance and use of electric propulsion. This paper outlines the power requirements of electric propulsion technology being developed today, including arcjets, magnetoplasmadynamic (MPD) thrusters, and ion engines. Power supply characteristics are discussed for nuclear, solar, and power-beaming systems. Operational characteristics are given for each, as are the impacts of the power supply alternative on the overall craft performance. Because of its modular nature, the power-beaming approach is able to meet the power requirements of all three electric propulsion types. Also, commonality of approach allows different electric propulsion approaches to be powered by a single power supply approach. Power beaming exhibits better flexibility and performance than on-board nuclear or solar power systems. DOE

**N91-32169#** Pacific Northwest Lab., Richland, WA.

**A POWER BEAMING BASED INFRASTRUCTURE FOR SPACE POWER**

J. A. Bamberger Aug. 1991 7 p Presented at the 26th Intersociety Energy Conversion Engineering (IECE) Conference, Boston, MA, 3-9 Aug. 1991
(Contract DE-AC06-76RL-01830)
(DE91-017533; PNL-SA-18950; CONF-910801-21) Avail: NTIS HC/MF A02

At present all space mission power requirements are met by integral, on-board, self-contained power systems. To provide needed flexibility for space exploration and colonization, an additional approach to on-board, self-contained power systems is needed. Power beaming, an alternative approach to providing power, has the potential to provide increased mission flexibility while reducing total mass launched into space. Laser-power beaming technology provides a viable power and communication infrastructure that can be developed sequentially as it is applied to power satellite constellations in Earth orbit and to orbital transport vehicles transferring satellites and cargos to geosynchronous orbit and beyond. Coupled with nuclear electric propulsion systems for cargo transport, the technology can be used to provide global power to the Lunar surface and to Mars' surface and moons. The technology can be developed sequentially as advances in power system and propulsion system technology occur. This paper presents stepwise development of an infrastructure based on power beaming that can support the space development and exploration goals of the Space Exploration Initiative. Power scenarios based on commonality of power systems hardware with cargo transport vehicles are described. Advantages of this infrastructure are described. DOE

**N91-32308#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

**SPACECRAFT POWER SYSTEM CONCERNS REGARDING FAILURE MODES WITHIN COMPLEX INTEGRATED CIRCUITS AND HYBRID PACKAGES**

J. E. Haines *In its* ESA Electronic Components Conference

Mar. 1991 p 121-125 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32311#** Plessey Research (Caswell) Ltd., Towcester (England).
**HIGH PERFORMANCE PACKAGES FOR SPACE APPLICATIONS**
K. Beasley and J. T. Lynch *In* ESA, ESA Electronic Components Conference Mar. 1991 p 139-143 (For primary document see N91-32291 24-33)
(Contract ESTEC-8058/88/NL/RE(SC))
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32312#** Alcatel Espace, Toulouse (France).
**QUALIFICATION STRATEGY FOR MULTI-CHIP PACKAGING FOR SPACE APPLICATIONS**
A. Bensoussan, G. Gregoris, and P. Coval *In* ESA, ESA Electronic Components Conference Mar. 1991 p 145-148 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32630*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**LIGHTNING PROTECTION FOR SHUTTLE PROPULSION ELEMENTS**
Carolyn C. Goodloe and Robert J. Giudici (Sverdrup Technology, Inc., Huntsville, AL.) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 21H

**N91-32656*#** Electro Magnetic Applications, Inc., Lakewood, CO.
**THE EFFECTS OF THE EXHAUST PLUME ON THE LIGHTNING TRIGGERING CONDITIONS FOR LAUNCH VEHICLES**
Frederick J. Eriksen, Terence H. Rudolph, and Rodney A. Perala *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 21H

# 23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

# 24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials*.

**N91-32170** Cranfield Inst. of Tech., Bedford (England).
**COMPOSITE-FACED SANDWICH CONSTRUCTION FOR PRIMARY SPACECRAFT STRUCTURES Ph.D. Thesis**
R. Slade 1989 453 p
Avail: Univ. Microfilms Order No. BRDX90899

The application of fiber reinforced composite materials to spacecraft sandwich structures was studied. In particular, aspects of the manufacture, analysis, and design optimization of components fabricated using the co-cure process were studied. The manufacturing process was developed to ultimately enable a full size thrust tube structure to be built using a single step cure, the design of which was verified by a modal survey test. Techniques for the analysis of stiffness, strength, vibration frequencies, and local instability were established and found to correlate well with tests on co-cured sandwich specimens. The current wrinkling theory for composite faced sandwich was extended to the more general case to allow facesheet constitutive matrix coupling and multiaxial loading to be accommodated. The analytical methods were incorporated within simple optimization schemes, willing to be used at the preliminary design stage, to allow alternative feasible designs for panel and thrust tube structures to be generated. These illustrated the benefits of the use of composite materials and the co-cure manufacturing technique for spacecraft sandwich components. Dissert. Abstr.

**N91-32171** Stanford Univ., CA.
**HIGH-TEMPERATURE THERMOMECHANICAL BEHAVIOR OF CARBON-PHENOLIC AND CARBON-CARBON COMPOSITES Ph.D. Thesis**
Hugh Leslie Nicholas McManus 1990 187 p
Avail: Univ. Microfilms Order No. DA9102313

The high temperature behavior of carbon-phenolic and carbon-carbon composites was studied. Models were developed which describe the thermal and mechanical responses of such composites when rapidly heated to temperatures as high as 3300 C. On the basis of the models, a computer code was written which provides the temperature and pressure distributions, vapor and volatile formation rates, amount of char, stress and strain, and damage in carbon-phenolic and carbon-carbon plates. To validate the model and the code, temperature distributions in and damage of rapidly heated carbon-phenolic composites were measured. The data compared well to the results calculated by the code. Parametric studies were performed, the results of which yield physical insights into the ply-lift phenomenon observed in solid rocket motor exit cone linings and provide a guide in the design of parts made of carbon-phenolic and carbon-carbon composites. Dissert. Abstr.

**N91-32172** Virginia Polytechnic Inst. and State Univ., Blacksburg.
**INTERLAMINAR DEFORMATIONS ON THE CYLINDRICAL SURFACE OF A HOLE IN LAMINATED COMPOSITES: AN EXPERIMENTAL STUDY Ph.D. Thesis**
Raymond G. Boeman 1990 184 p
Avail: Univ. Microfilms Order No. DA9118788

Free edge effects in composite laminates were studied experimentally. Strains were determined and compared on a ply-by-ply basis for the curved edges of a hole in thick composite panels and along the straight free edge of the panels. The experimental technique of moire interferometry was extended to take measurements of in-plane deformations on singly curved surfaces. Eight thick composite laminates from three material systems were tested in uniaxial compression on a screw driven testing machine. Interlaminar deformations were measured at the straight free edge on four of the specimens. Strain distribution on the straight free edge was compared with FEM results for two specimens. Interlaminar deformations were measured on a ply-by-ply basis for the first time on the cylindrical surface of a hole for six of the specimens. Interlaminar shear strain along a 0/90 deg interface was measured and plotted as a function of the angular position for a cross ply specimen. The shape of the curve compares favorably with analytical results found in the literature for a similar geometry. Dissert. Abstr.

**N91-32173** Rensselaer Polytechnic Inst., Troy, NY.
**MATRIX-DOMINATED THERMOVISCOPLASTICITY IN FIBROUS METAL-MATRIX COMPOSITE MATERIALS Ph.D. Thesis**
Richard Brian Hall 1990 327 p
Avail: Univ. Microfilms Order No. DA9120222

A small strain theory of high temperature, anisothermal viscoplastic behavior for a fibrous, metal matrix composite lamina

is presented. Following the bimodal plasticity theory of Dvorak and Bahei-El-Din, it is assumed that certain stress states produce plastic deformation by inducing matrix slip on planes containing the fiber axis, in a way anomalous to the deformation of single crystals. Such matrix dominated mode (MDM) behavior is found to dominate the responses to off-axis loading of typical systems with the axial shear stiffness of the fibers substantially exceeding that of the matrix, becoming the dominant mode in typical laminates. The viscoplasticity formulation of Yen and Eisenberg is adapted to govern the responses of the active slip planes, extended to anisothermal conditions following the thermal decomposition theory of Dvorak. The mechanical component of the growth law for the backstress permits the introduction of an arbitrary hardening direction. Although a suitable framework for general stress states is presented, certain constitutive functions are fully expressed only for the plane stress case. Dissert. Abstr.

**N91-32174** National Physical Lab., Teddington (England). Composite and Comparison Properties Branch.
**STANDARDS FOR POLYMER MATRIX COMPOSITES. PART 2: ASSESSMENT AND COMPARISON OF CRAG TEST METHODS**
Graham D. Sims Nov. 1990 38 p
(NPL-DMM(A)-7-Pt-2; ISSN-0959-2423; ETN-91-90021)
Copyright Avail: National Physical Lab., Teddington, TW11 0LW, England

The Composites Research Advisory Group (CRAG) test methods for polymer matrix composites are compared with similar methods in other new initiatives in U.S., Japan and Europe and with existing international standards. A large degree of similarity is found for the major aspects of the tests together with a need for further development of minor detailing. The CRAG test methods have a particular advantage in that the methods are recommended for all textile diameter fibers (carbon, glass and aramid) in unidirectional, multidirectional and fine fabric form. This is a major advantage for engineering property data bases for design, and for material specification purposes. The preferred course of action proposed is that round robin validation be conducted on methods derived from CRAG. ESA

**N91-32175#** Construcciones Aeronauticas S.A., Madrid (Spain). Subdireccion de Investigacion y Desarrollo de Tecnologia y Materiales.
**TESTS OF SALINIC CLOUDS IN TEST TUBE OF THE 7075 CARBON FIBER WITH METAL MESH (AIRBUS 330/340) [ENSAYO DE NIEBLA SALINA EN PROBETAS DE 7075/FIBRA DE CARBONO CON MALLA METALICA (AIRBUS 330/340)]**
1990 11 p In SPANISH
(Informe-I-520/90; ETN-91-90058) Avail: NTIS HC/MF A03

Results obtained in corrosion resistance tests of two types of metal mesh in carbon fiber laminate are summarized. The aim of the tests was to evaluate the galvanic corrosion possibility in metal-carbon contact that could happen is these types of configuration, used as protection against beams in the A-330/340 program. ESA

**N91-32176#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Structures and Mechanisms Div.
**GUIDELINES FOR CARBON AND OTHER ADVANCED FIBRE PREPREG PROCUREMENT SPECIFICATIONS**
Dec. 1990 33 p
(ESA-PSS-03-207-Issue-1; ISSN-0379-4059; ETN-91-90061)
Copyright Avail: NTIS HC/MF A03

A guideline to assist in the preparation of a specification for the procurement of advanced composite prepregs are presented. The guideline is biased particularly towards the special requirements of carbon fiber reinforced plastics for use in spacecraft structures. ESA

**N91-32177*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**EFFECT OF LIGHTNING STRIKE ON BROMINE INTERCALATED GRAPHITE FIBER/EPOXY COMPOSITES**
James R. Gaier, Melissa E. Slabe, and Norman O. Brink (Rohr Industries, Inc., Chula Vista, CA.) Aug. 1991 19 p
(NASA-TM-104507; E-6370; NAS 1.15:104507) Avail: NTIS HC/MF A03 CSCL 11D

Laminar composites were fabricated from pristine and bromine intercalated pitch based graphite fibers. It was found that laminar composites could be fabricated using either pristine or intercalated graphite fibers using standard fabrication techniques. The intercalated graphite fiber composites had electrical properties which were markedly improved over both the corresponding pitch based and polyacrylonitrile (PAN) based composites. Despite composites resistivities more than an order of magnitude lower for pitch based fiber composites, the lightning strike resistance was poorer than that of the Pan based fiber composites. This leads to the conclusion that the mechanical properties of the pitch fibers are more important than electrical or thermal properties in determining the lightning strike resistance. Based on indicated lightning strike tolerance for high elongation to failure materials, the use of vapor grown, rather than pitch based graphite fibers appears promising. Author

**N91-32178#** Pennsylvania State Univ., University Park. Center for Advanced Materials.
**PROJECTS WITHIN THE CENTER FOR ADVANCED MATERIALS Annual Report, 1 Jun. 1989 - 31 May 1990**
J. R. Hellmann and S. R. Nestlerode Mar. 1991 566 p
(Contract GRI-5084-238-1302)
(PB91-205716; CAM-9002; GRI-90/0205) Avail: NTIS HC/MF A24 CSCL 11D

The Gas Research Institute (GRI) has recognized an opportunity for improving gas fired industrial utilization technology through the application of advanced high temperature materials. The research projects were in three major areas: technology assessment and dissemination; analytical and engineering services; and research. Partial contents are as follows: technology assessment and transfer; ceramic composites; thermal shock behavior; physical property measurements of high temperature composites; failure analysis and materials characterization; gas boosting of glass melting; high temperature corrosion resistant metal based materials for gas fired systems; durability of nonoxide ceramics in simulated heat treatment environments; and wear mechanisms in structural ceramics. Author

**N91-32179#** Oak Ridge National Lab., TN.
**TENSILE AND CYCLIC FATIGUE PROPERTIES OF SiC WHISKER-REINFORCED Al2O3**
K. C. Liu, C. O. Stevens, and C. R. Brinkman 1991 13 p Presented at the 1st Canadian International Composites Conference and Exhibition, Montreal, Quebec, 4-6 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE91-015916; CONF-9109229-1) Avail: NTIS HC/MF A03

Uniaxial tensile and cyclic fatigue data are reported for a commercial grade of SiC whisker-reinforced Al2O3 matrix composite tested at room temperature. Test results show that the average tensile strength of this composite material was 432 MPa, which was higher than that of monolithic Al2O3 by about 40 percent. The tensile strength was reproducible within plus or minus 5.5 percent of the mean, indicating the value of the Weibull modulus of the composite was high. While the fatigue strength of monolithic Al2O3 in the high-cycle range fell to about two thirds of the tensile strength, the composite showed practically no reduction in strength due to cyclic fatigue loading. The fatigue strength of the composite was found to be about 95 percent of its tensile strength. This observation suggests that addition of SiC whiskers in Al2O2O3 matrix can effectively inhibit the cyclic fatigue crack growth in the composite, hence enhancing the resistance to fatigue and improve its tensile strength. DOE

**N91-32180*#** Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
**STRUCTURAL CHARACTERIZATION OF HIGH TEMPERATURE COMPOSITES Final Report, 10 Dec. 1982 - 30 Sep. 1985**
J. F. Mandell and D. H. Grande Oct. 1991 59 p

(Grant NsG-377)
(NASA-CR-187220; NAS 1.26:187220) Avail: NTIS HC/MF A04 CSCL 11D

Glass, ceramic, and carbon matrix composite materials have emerged in recent years with potential properties and temperature resistance which make them attractive for high temperature applications such as gas turbine engines. At the outset of this study, only flexural tests were available to evaluate brittle matrix composites at temperatures in the 600 to 1000 C range. The results are described of an ongoing effort to develop appropriate tensile, compression, and shear test methods for high temperature use. A tensile test for unidirectional composites was developed and used to evaluate the properties and behavior of ceramic fiber reinforced glass and glass-ceramic matrix composites in air at temperatures up to 1000 C. The results indicate generally efficient fiber reinforcement and tolerance to matrix cracking similar to polymer matrix composites. Limiting properties in these materials may be an inherently very low transverse strain to failure, and high temperature embrittlement due to fiber/matrix interface oxidation. Author

**N91-32181*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**INTEGRATED MECHANICS FOR THE PASSIVE DAMPING OF POLYMER-MATRIX COMPOSITES AND COMPOSITE STRUCTURES**
D. A. Saravanos (Case Western Reserve Univ., Cleveland, OH.) and Christos C. Chamis 1991 27 p Presented at the Mechanics and Mechanisms of Materials Damping Conference, Baltimore, MD, 13-15 Mar. 1991; sponsored by the American Society for Testing and Materials
(NASA-TM-104346; E-6120; NAS 1.15:104346) Avail: NTIS HC/MF A01 CSCL 11D

Some recent developments on integrated damping mechanics for unidirectional composites, laminates, and composite structures are reviewed. Simplified damping micromechanics relate the damping of on-axis and off-axis composites to constituent properties, fiber volume ratio, fiber orientation, temperature, and moisture. Laminate and structural damping mechanics for thin composites are summarized. Discrete layer damping mechanics for thick laminates, including the effects of interlaminar shear damping, are developed and semianalytical predictions of modal damping in thick simply supported specialty composite plates are presented. Applications show the advantages of the unified mechanics, and illustrate the effect of fiber volume ratio, fiber orientation, structural geometry, and temperature on the damping. Additional damping properties for composite plates of various laminations, aspect ratios, fiber content, and temperature illustrate the merits and ranges of applicability of each theory (thin or thick laminates). Author

**N91-32182*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**PROGRESSIVE FRACTURE IN COMPOSITES SUBJECTED TO HYGROTHERMAL ENVIRONMENT**
Levon Minnetyan (Clarkson Univ., Potsdam, NY.), Pappu L. N. Murthy, and Christos C. Chamis 1991 35 p Presented at the 32nd Structures, Structural Dynamics, and Materials Conference, Baltimore, MD, 8-10 Apr. 1991; sponsored in part by AIAA, ASME, ASCE, AHS, and ASC Previously announced in IAA as 91-31919
(NASA-TM-105230; E-6553; NAS 1.15:105230) Avail: NTIS HC/MF A03 CSCL 11D

The influence of hygrothermal environmental conditions on the load carrying ability and response of composite structures are investigated via computational simulation. An integral computer code is utilized for the simulation of composite structural degradation under loading. Damage initiation, damage growth, fracture progression, and global structural fracture are included in the simulation. Results demonstrate the significant hygrothermal effects on composite structural response, toughness, and durability. Author

**N91-32183** Stanford Univ., CA.
**DELAMINATIONS IN COMPOSITE PLATES UNDER TRANSVERSE STATIC OR IMPACT LOADS Ph.D. Thesis**
Scott R. Finn 1991 245 p
Avail: Univ. Microfilms Order No. DA9122532 CSCL 11D

A method is presented for calculating the locations, shapes, and sizes of delaminations which occur in a fiber reinforced composite plate subjected to transverse static or dynamic (impact) loads. The plate may be simply supported, clamped, or free along its edges. A failure model of the delamination formation was developed. This model was then coupled with a finite element analysis. The model and the finite element analysis were then implemented by a computer code (IMPACT-ST) which can be used to estimate the load at which damage initiates as well as the locations, shapes, and sizes of the delaminations. Tests were also performed measuring the geometries of delaminations in Fiberite T300/976 graphite-epoxy, Fiberite IM7/977-2 graphite toughened epoxy, and ICI APC-2 graphite-PEEK plates subjected to transverse static and impact loads. The data was compared to results of the model and good agreements were found between the measured and calculated delamination lengths and widths. Dissert. Abstr.

**N91-32184** Georgia Inst. of Tech., Atlanta.
**FAILURE MECHANISMS AND PREDICTION IN ADVANCED COMPOSITE MATERIALS Ph.D. Thesis**
Kemal Levend Parnas 1990 213 p
Avail: Univ. Microfilms Order No. DA9124541

The failure mechanisms in composite rotorcraft structures were investigated. The crippling of thin walled composite members and the delamination of tapered composite laminates were chosen as two generic applications. One is from the airframe, while the other is from the rotary components. I-section beams were used for the failure characterization of thin walled members. The local buckling, postbuckling, and crippling analysis results were compared with data obtained from compression tests. Further, a linear law for crippling was developed. An analysis of the delamination in tapered composite laminates under tensile loading was performed. Energy based methods were used to determine interlaminar stresses. The total strain energy release rate which governs the delamination behavior was determined using a simplified model. The research enables the implementation of the weight savings potential of composites and provide guidelines for the design of thin wall and tapered laminated composite components. Dissert. Abstr.

**N91-32185*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**MATERIALS AND PROCESSES LABORATORY COMPOSITE MATERIALS CHARACTERIZATION TASK, PART 1. DAMAGE TOLERANCE**
A. T. Nettles, D. S. Tucker, W. J. Patterson, S. W. Franklin, G. H. Gordon, L. Hart, A. J. Hodge, D. G. Lance, and S. S. Russel Sep. 1991 31 p
(NASA-TM-103553; NAS 1.15:103553) Avail: NTIS HC/MF A03 CSCL 11D

A test run was performed on IM6/3501-6 carbon-epoxy in which the material was processed, machined into specimens, and tested for damage tolerance capabilities. Nondestructive test data played a major role in this element of composite characterization. A time chart was produced showing the time the composite material spent within each Branch or Division in order to identify those areas which produce a long turnaround time. Instrumented drop weight testing was performed on the specimens with nondestructive evaluation being performed before and after the impacts. Destructive testing in the form of cross-sectional photomicrography and compression-after-impact testing were used. Results show that the processing and machining steps needed to be performed more rapidly if data on composite material is to be collected within a reasonable timeframe. The results of the damage tolerance testing showed that IM6/3501-6 is a brittle material that is very susceptible to impact damage. Author

**N91-32186#** Oregon State Univ., Newport. Dept. of Nuclear Engineering.
**MATERIALS COMPATIBILITY ISSUES FOR FABRIC COMPOSITE RADIATORS**
T. S. Marks and A. C. Klein 1991 6 p Presented at the 8th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 6-10 Jan. 1991
(Contract DE-FG07-89ER-12901)
(DE91-017556; CONF-910116-22) Avail: NTIS HC/MF A02

Short term materials compatibility tests have been completed on potential materials to be used in fabric composite radiators for space applications. Specific materials tested include copper, aluminum, titanium, FEP Teflon tubing, and three high strength fabric fibers: alumina-boria-silica, silicon carbide, and silicon dioxide. These materials have been exposed to pure water, methanol, and acetone for periods of time up to 5000 hours at variety of appropriate temperatures. DOE

**N91-32605*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**MODELING OF ELECTRICALLY THICK MATERIALS THEORETICAL AND EXPERIMENTAL ASPECTS**
V. Gobin, F. Issac, and F. Jaillot *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced in IAA as A91-45609 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 11D

**N91-32606*#** United Kingdom Atomic Energy Authority, Abingdon (England). Lightning Test and Technology.
**INVESTIGATIONS INTO THE DAMAGE FOR VARIOUS TYPES OF UNPROTECTED CARBON FIBRE COMPOSITES WITH A VARIETY OF LIGHTNING ARC ATTACHMENTS**
G. W. Reid *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 11D

# 25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

**N91-32187*#** Oregon Univ., Eugene. Chemical Physics Inst.
**IONIZATION OF NO AT HIGH TEMPERATURE Final Report, Jan. - Nov. 1991**
C. Frederick Hansen 1991 35 p
(Grant NAG1-1211)
(NASA-CR-188798; NAS 1.26:188798) Avail: NTIS HC/MF A03 CSCL 21B

Space vehicles flying through the atmosphere at high speed are known to excite a complex set of chemical reactions in the atmospheric gases, ranging from simple vibrational excitation to dissociation, atom exchange, electronic excitation, ionization, and charge exchange. Simple arguments are developed for the temperature dependence of the reactions leading to ionization of NO, including the effect of vibrational electronic thermal nonequilibrium. NO ionization is the most important source of electrons at intermediate temperatures and at higher temperatures provides the trigger electrons that ionize atoms. Based on these arguments, recommendations are made for formulae which fit observed experimental results, and which include a dependence on both a heavy particle temperature and different vibration electron temperatures. In addition, these expressions will presumably provide the most reliable extrapolation of experimental results to much higher temperatures. Author

**N91-32188#** Norwegian Defence Research Establishment, Kjeller.
**ANALYSIS OF SAMPLES FOR THE SECOND (1990) ROUND ROBIN INTERLABORATORY EXERCISE**
John Aa Toernes and Bjoern A. Johnsen 22 May 1991 47 p
(FFI-91/6004; ISSN-0802-2437; ETN-91-90055) Avail: NTIS HC/MF A03

Samples obtained during an inspection of a schedule 3 facility are analyzed as part of a round robin interlaboratory exercise. Seven schedules compounds were identified. Dimethyl methylphosphonate is a schedule 2 compound while trimethyl phosphite, ethyl dimethyl phosphite, diethyl methyl phosphite, dimethyl phosphite, triethyl phosphite and ethyl methyl phosphite are schedule 3 compounds. Detailed information about the production was revealed during the analysis of the samples. This should, if possible, be avoided by screening the samples for relevant compounds only. ESA

**N91-32189#** Los Alamos National Lab., NM.
**THE APPLICATION OF TIME-RESOLVED LUMINESCENCE SPECTROSCOPY TO A REMOTE URANYL SENSOR**
P. T. Varineau, R. Duesing, and L. E. Wangen 1991 12 p Presented at the SPIE Meeting, Boston, MA, 3-6 Sep. 1991
(Contract W-7405-eng-36)
(DE91-016310; LA-UR-91-2535; CONF-9109230-1) Avail: NTIS HC/MF A03

Time resolved luminescence spectroscopy is an effective method for the determination of a wide range of uranyl concentrations in aqueous samples. We have applied this technique to the development of a remote sensing device using fiber optic cables coupled with a micro flow cell in order to probe for uranyl in aqueous samples. This sensor incorporates a Nafion membrane through which UO2 (exp 2+) can diffuse into a reaction/analysis chamber which holds phosphoric acid, a reagent which enhances the uranyl luminescence intensity and lifetime. With this device, anionic and fluorescing organic interferences could be eliminated, allowing for the determination of uranyl over a concentration range of 10(exp 4) to 10(exp -9)M. DOE

**N91-32190#** Yale Univ., New Haven, CT. Dept. of Chemical Engineering.
**CATALYTIC COMBUSTION OF METHANE Final Report, 1 Jan. 1986 - 30 May 1990**
L. D. Pfefferle and M. D. Smooke May 1991 108 p
(Contract GRI-5086-260-1249)
(PB91-206391; GRI-91/0073) Avail: NTIS HC/MF A06 CSCL 21B

Catalytically stabilized combustion represents an extremely promising but underexploited technology. Catalytic combustors can be designed to combine the high reaction rates of thermal combustors with the low NO(x) and soot levels of conventional catalytic oxidation reactors, and catalytic flame stabilization devices can be used to significantly improve the performance of conventional flame combustors. The research focussed on examining the basic chemical and transport mechanisms from a fundamental point of view with the objective of determining how these mechanisms affect design considerations. The results are summarized with respect to the effect of a platinum catalyst on the concentration of oxidizing radicals (O, OH) in a combustion boundary layer at both atmospheric and reduced pressures and the relation of this effect on gas phase combustion propagation. The analysis includes a reacting boundary layer model for combustion of methane over reactive and nonreactive surfaces. Thermal diffusion, complex chemistry in the gas phase, surface oxidation of methane and surface production of OH were considered. Author

**N91-32191#** Texas A&M Univ., College Station. Dept. of Chemistry.
**NEW DIRECTIONS FOR THE CATALYTIC CONVERSION OF METHANE Annual Report, Jan. - Dec. 1990**
J. H. Lunsford Jan. 1991 49 p

(Contract GRI-5086-260-1326)
(PB91-206417; GRI-91/0050) Avail: NTIS HC/MF A03 CSCL 07D

The primary goal of research on the oxidative coupling of methane is to develop an active and stable catalyst that will convert methane to ethylene. Since ethane is the initial hydrocarbon product formed during the oxidative coupling reaction, it is essential that the in situ oxidative dehydrogenation (OXD) of ethane be achieved with a high degree of selectivity. By introducing chlorine into a Li(+)-MgO catalyst, it has been possible to attain large ethylene to ethane ratios for periods in excess of 250 hrs. This long life of the material, which is unique among chlorine promoted catalysts for these reactions, is, in part, a result of the fact that the catalysts usually operate at the relatively mild temperature of 650 C. The large ethylene to ethane ratios achieved during the oxidative coupling reaction suggest that these catalysts should be effective for the OXD of ethane, and indeed they have been shown to be superior catalysts for this reaction. Author

**N91-32192#** Akron Univ., OH. Dept. of Chemical Engineering.
**THE EFFECT OF CHEMICAL ADDITIVES ON THE SYNTHESIS OF ETHANOL**
S. S. C. Chuang May 1991 9 p
(Contract DE-FG22-87PC-79923)
(DE91-016586; DOE/PC-79923/T7) Avail: NTIS HC/MF A02

The objective of this research is to elucidate the role of additives on the methanol synthesis over Rh- and Ni-based catalysts. Chemical additives used for this study will include S, P, Ag, Cu, Mn, and Na which have different electronegativities. The effect of additives on the surface state of the catalysts, heat of adsorption of reactant molecules, reaction intermediates, reaction pathways, reaction kinetics, and product distributions is/will be investigated by a series of experimental studies of NO adsorption, reaction probing, steady state rate measurement, and transient kinetic study. A better understanding of the role of additive on the synthesis reaction may allow us to use chemical additives to manipulate the catalytic properties of Rh- and Ni-based catalysts for producing high yields of ethanol from syngas. DOE

**N91-32193#** Lehigh Univ., Bethlehem, PA.
**HIGH OCTANE ETHERS FROM SYNTHESIS GAS-DERIVED ALCOHOLS**
K. Klier, R. G. Herman, R. D. Bastian, and S. DeTavernier Apr. 1991 30 p
(Contract DE-AC22-90PC-90044)
(DE91-016596; DOE/PC-90044/2) Avail: NTIS HC/MF A03

The objective of the proposed research is to synthesize high octane ethers, primarily methyl isobutyl ether (MIBE) and methyl tertiary butyl ether (MTBE), directly from H2/CO/CO2 coal-derived synthesis gas via alcohol mixtures that are rich in methanol and 2-methyl-1-butanol (isobutanol). The overall scheme involves gasification of coal, purification and shifting of the synthesis gas, higher alcohol synthesis, and direct synthesis of ethers. The last stage of the synthesis involves direct coupling of synthesis gas-derived methanol and isobutanol that has been demonstrated by us to occur over superacid catalysts to yield methyl isobutyl ether (MIBE) at moderate pressures and a mixture of methanol and isobutene at low pressures. This will be achieved by the proper choice of reaction conditions, i.e., intermediate pressures, and of inorganic acid catalysts that are stable at temperatures higher than 200 C, at which the carbonium ion reaction coupling of the two alcohols to MTBE is more effective than the oxonium ion or ester reaction coupling to MIBE. Both organic and inorganic catalysts will be investigated. This quarter, the catalysts investigated were the Dow Chemical Co. fluorocarbon sulfonic acid and (FSA) resin supported on SiC and the DuPont Nafion-H microsaddles. DOE

**N91-32194#** Sandia National Labs., Albuquerque, NM.
**EFFECT OF INITIAL CONDITIONS ON COMBUSTION GENERATED LOADS**
S. R. Tieszen 1991 21 p Presented at the 11th Structural Mechanics in Reactor Technology, Shanghai (China), 14-16 Aug. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016646; SAND-91-1348C; CONF-9108128-1) Avail: NTIS HC/MF A03

This analytical study examines the effect of initial thermodynamic conditions on the loads generated by the combustion of homogeneous hydrogen-air-steam mixtures. The effect of initial temperature, pressure, hydrogen concentration, and steam concentration is evaluated for two cases, constant volume and constant initial pressure. For each case, the Adiabatic, Isochoric, Complete Combustion (AICC), Chapman-Jouguet (CJ), and normally reflected CJ pressures are calculated for a range of hydrogen and steam concentrations representative of the entire flammable regime. For detonation loads, pressure profiles and time-histories are also evaluated in one-dimensional Cartesian geometry. The results show that to a first approximation, the AICC and CJ pressures are directly proportional to the initial density. Increasing the hydrogen concentration up to stoichiometric concentrations significantly increases the AICC, CJ, and reflected CJ pressures. For the constant volume case, the AICC, CJ, and reflected CJ pressures increase with increasing hydrogen concentration on the rich side of stoichiometric concentrations. For the constant initial pressure case, the AICC, CJ and reflected CJ pressures decrease with increasing hydrogen concentration on the rich side of stoichiometric values. The addition of steam decreases the AICC, CJ and reflected CJ pressures for the constant initial pressure case, but increases them for the constant volume case. For detonations, the pressure time-histories can be normalized with the AICC pressure and the reverberation time for Cartesian geometry. DOE

**N91-32195#** California Univ., Berkeley. Lawrence Berkeley Lab.
**EQUATIONS OF STATE FOR SOLID NaCl-KCl AND LIQUID NaCl-KCl-H2O**
K. S. Pitzer and S. M. Sterner Jun. 1991 11 p Presented at the 11th Symposium on Thermophysical Properties, Boulder, CO, 23-27 Jun. 1991
(Contract DE-AC03-76SF-00098)
(DE91-016980; LBL-30916; CONF-9106176-5) Avail: NTIS HC/MF A03

The equilibrium between the solid solution of NaCl-KCl and the ternary liquid NaCl-KCl-H2O is both scientifically interesting and geologically important. Equations of the Margules type have been derived for the two phases that accurately reproduce the extensive array of published measurements, together with recent measurements for the liquids of the ternary and the solution of the NaCl-KCl binary. The range of validity of the equations extends to 1200 K, to 5 kbar, but for aqueous systems it is limited to compositions on the salt saturation surface. Of particular interest is the transition in the liquid-solid equilibrium of the ternary from the pattern at high temperatures where the solid is a solution of composition near that of the liquid to that at lower temperatures where the solid is nearly pure NaCl or KCl. The phase compositions for anhydrous NaCl-KCl are consistent with published heat of mixing data and yield a new expression for the entropy of mixing. DOE

**N91-32196*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**IGNITABILITY TEST METHOD AND APPARATUS Patent**
Laurence J. Bement, inventor (to NASA), James W. Bailey, inventor (to NASA), and Morry L. Schimmel, inventor (to NASA) 1 Oct. 1991 11 p Filed 4 Oct. 1990 Continuation-in-part of abandoned US-Patent-Appl-SN-426345, filed 30 Nov. 1989
(NASA-Case-LAR-14454-1; US-Patent-5,052,817;
US-Patent-Appl-SN-593412; US-Patent-Appl-SN-426345;
US-Patent-Class-374-8; US-Patent-Class-73-167;
US-Patent-Class-102-200; Int-Patent-Class-G01N-25/50) Avail: US Patent and Trademark Office CSCL 21B

An apparatus for testing ignitability of an initiator includes a body having a central cavity, an initiator holder for holding the initiator over the central cavity of the body, an ignition material holder disposed in the central cavity of the body and having a

cavity facing the initiator holder which receives a measured quantity of ignition material to be ignited by the initiator. It contains a chamber in communication with the cavity of the ignition material and the central cavity of the body, and a measuring system for analyzing pressure characteristics generated by ignition of the ignition material by the initiator. The measuring system includes at least one transducer coupled with an oscillograph for recording pressure traces generated by ignition.

Official Gazette of the U.S. Patent and Trademark Office

**N91-32197#** Lawrence Livermore National Lab., CA.
**AUTOIGNITION CHEMISTRY OF C4 OLEFINS UNDER MOTORED ENGINE CONDITIONS: A COMPARISON OF EXPERIMENTAL AND MODELING RESULTS**
W. J. Pitz, C. K. Westbrook, and W. R. Leppard (General Motors Research Labs., Warren, MI.) Jun. 1991 36 p Presented at the Society of Automotive Engineers International Fuels and Lubricants Meeting and Exposition, Toronto (Canada), 7-10 Oct. 1991
(Contract W-7405-eng-48)
(DE91-016511; UCRL-JC-107436; CONF-911025-2) Avail: NTIS HC/MF A03

A detailed chemical kinetic mechanism was used to simulate the oxidation of 1-butene, 2-butene, and isobutene under motored engine conditions. Predicted species concentrations were compared to measured species concentrations obtained from a motored, single-cylinder engine. The chemical kinetic model reproduced correctly the trends in the measured species concentrations. The computational and experimental results showed the main features of olefin chemistry: radical addition to the double bond leads to the production of the observed carbonyls and epoxides. For isobutene oxidation, the production of unreactive, 2-methyl allyl radicals leads to higher molecular-weight species and chain termination. DOE

**N91-32198#** City Coll. of the City Univ. of New York, NY. Inst. for Physicochemical Hydrodynamics.
**STUDIES IN PREMIXED COMBUSTION**
G. I. Sivashinsky 1991 6 p
(Contract DE-FG02-88ER-13822)
(DE91-016964; DOE/ER-13822/4) Avail: NTIS HC/MF A02

A brief discussion of turbulent flame propagation theory is present which covers the following areas: (1) pockets in premixed combustion and combustion rate; (2) renormalization of Markstein's Length in premixed flames moving through the turbulent flow field; and (3) flame extinction by periodic flow field. A brief discussion of pattern formation in premixed flames and related problems is presented in which the following topics are covered: (1) on slot-burner polyhedral flames; (2) negative burning speed in oscillatory premixed gas combustion; (3) the model equation for oscillatory gasless combustion; (4) instabilities and pattern formation in large-scale premixed flames propagating between closely spaced horizontal plates; (5) the effect of thermal expansion on the structure of Bunsen-type flames; and (6) hexagonal structure of large-scale Marangoni Convection. DOE

**N91-32199#** Sandia National Labs., Albuquerque, NM.
**CONSTITUTIVE MODELING OF SALT BEHAVIOR: STATE OF THE TECHNOLOGY**
D. E. Munson and W. R. Wawersik 1991 15 p Presented at the 7th International Congress on Rock Mechanics, Aachen (Germany), 16-20 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE91-017459; SAND-91-1614C; CONF-910907-5) Avail: NTIS HC/MF A03

The modern investigation of the thermochemical behavior of salt started in the mid-1930's and, for what appears to be a very narrow discipline, salt mechanics has acquired considerable technical depth and sophistication. The last three decades have been especially productive in constitutive model development and laboratory investigations of time-dependent creep behavior. This has been largely due to anticipated use of domal or bedded salt deposits as sites for radioactive waste repositories and to expanded need for hydrocarbon and feedstock storage caverns. Salt is an interesting material, in that it is metal like and, therefore, constitutive modeling can draw upon a large body of metal deformation information to arrive at appropriate models of behavior. Testing apparatus and methods have centered on either uniaxial or triaxial compression to obtain steady state and transient creep responses. Flow and fracture potentials have been defined. Validation attempts of the models against field data, although limited, have proved promising. DOE

**N91-32550*#** EMEC Consultants, Export, PA.
**ELECTROLYTIC PRODUCTION OF OXYGEN FROM LUNAR RESOURCES**
Rudolf Keller *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 1-6
(For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 07D

# 26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

**N91-32200*#** Grumman Aerospace Corp., Bethpage, NY.
**EFFECT OF THERMAL EXPOSURE, FORMING, AND WELDING ON HIGH-TEMPERATURE, DISPERSION-STRENGTHENED ALUMINUM ALLOY: Al-8Fe-1V-2Si Final Report, May 1989 - Jun. 1991**
J. R. Kennedy, P. S. Gilman, M. S. Zedalis, D. J. Skinner, and J. M. Peltier Aug. 1991 133 p Prepared in cooperation with Allied-Signal Corp., Morristown, NJ
(Contract NAS1-18533)
(NASA-CR-187575; NAS 1.26:187575; RE-787) Avail: NTIS HC/MF A07 CSCL 11F

The feasibility of applying conventional hot forming and welding methods to high temperature aluminum alloy, Al-8Fe-1V-2Si (FVS812), for structural applications and the effect of thermal exposure on mechanical properties were determined. FVS812 (AA8009) sheet exhibited good hot forming and resistance welding characteristics. It was brake formed to 90 deg bends (0.5T bend radius) at temperatures greater than or equal to 390 C (730 F), indicating the feasibility of fabricating basic shapes, such as angles and zees. Hot forming of simple contoured-flanged parts was demonstrated. Resistance spot welds with good static and fatigue strength at room and elevated temperatures were readily produced. Extended vacuum degassing during billet fabrication reduced porosity in fusion and resistance welds. However, electron beam welding was not possible because of extreme degassing during welding, and gas-tungsten-arc welds were not acceptable because of severely degraded mechanical properties. The FVS812 alloy exhibited excellent high temperature strength stability after thermal exposures up to 315 C (600 F) for 1000 h. Extended billet degassing appeared to generally improve tensile ductility, fatigue strength, and notch toughness. But the effects of billet degassing and thermal exposure on properties need to be further clarified. The manufacture of zee-stiffened, riveted, and resistance-spot-welded compression panels was demonstrated. Author

**N91-32201** National Physical Lab., Teddington (England). Div. of Materials Metrology.
**A LITERATURE REVIEW OF INCLUSION REMOVAL BY FILTRATION AND FLOTATION**
K. C. Mills Mar. 1991 68 p Sponsored in part by Commission of the European Communities
(NPL-DMM(A)-13; ISSN-0143-7313; ETN-91-99874) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 OLW, England

Following the successful application of filtration techniques to the removal of inclusions from aluminum alloys and superalloys there has been much interest in the extension of these techniques to steels. Work carried out on the removal of solid and liquid

inclusions by the use of ceramic filters and gas bubbling is reviewed with particular attention being paid to the fundamentals underlying these processes. ESA

**N91-32202** National Physical Lab., Teddington (England). Div. of Materials Metrology.
**EFFECT OF PRIOR MECHANICAL DEFORMATION ON HYDROGEN TRANSPORT THROUGH 13 PERCENT CHROMIUM MARTENSITIC STAINLESS STEEL**
R. B. Hutchings and A. Turnbull Feb. 1991 30 p
(NPL-DMM(A)-14; ISSN-0959-2423; ETN-91-99875) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 OLW, England

Hydrogen permeation measurements were made on a 13 percent chromium martensitic stainless steel which had been previously mechanically deformed. Tensile deformation was applied up to strains of 8 percent, corresponding to the Ultimate Tensile Strength (UTS) and cold rolling was used to generate higher levels of deformation up to 50 percent. Analysis of the permeation transients for strains below UTS has shown a small but significant increase in the number of reversible trap sites, which is consistent with their association with dislocations. There was little change in the number of irreversible trap sites by virtue of maintaining the strain below the level at which significant interfacial separation could occur. The results of this study confirm that the major reversible trap sites in this steel are associated with dislocations. ESA

**N91-32203#** Norwegian Defence Research Establishment, Kjeller.
**INSTABILITY OF SHAPED CHARGED JETS WITH GENERAL CONSTITUTIVE EQUATIONS**
John Moxnes 6 May 1991 76 p
(FFI-91/4004; ISSN-0802-2437; ETN-91-90053) Avail: NTIS HC/MF A05

Metal jets (or rods) that are plastically stretching break up into a series of particles along the axis of symmetry. The particulation process stops the plastic elongation. The particles are of approximately the same length, indicating the existence of a critical wavelength for which the growth of an initial disturbance is greatest. The stability of stretching plastic jets is studied under the assumptions that the equation describing the perturbed flow is linear, and the material obeying the Zerilli-Armstrong constitutive equation. It is found that both very great wavelengths and very small wavelengths are stable. When the dynamic pressure is slightly less than the quasi-static stress, wavelengths that are unstable are found with the most unstable ones of the order of the radius to the jet. It is also found that the strain rate dependence on the constitutive equation is found to strongly reduce the instability, and the strain hardening does not have great influence on the instability. It is found that as time passes smaller and smaller wavelengths become unstable, and they finally catch up with the initially more unstable longer waves. ESA

**N91-32204*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**A NEW APPROXIMATE SUM RULE FOR BULK ALLOY PROPERTIES**
Guillermo Bozzolo (Analex Corp., Brook Park, OH.) and John Ferrante Oct. 1991 10 p
(NASA-TM-105282; E-6606; NAS 1.15:105282) Avail: NTIS HC/MF A02 CSCL 11F

A new, approximate sum rule is introduced for determining bulk properties of multicomponent systems, in terms of the pure components properties. This expression is applied for the study of lattice parameters, cohesive energies, and bulk moduli of binary alloys. The correct experimental trends (i.e., departure from average values) are predicted in all cases. Author

**N91-32205#** California Univ., Los Angeles. Dept. of Chemistry and Biochemistry.
**MULTIHETEROMACROCYCLES THAT COMPLEX METAL IONS**
D. J. Cram 1 Jul. 1991 8 p
(Contract DE-FG03-88ER-13892)
(DE91-016292; DOE/ER-13892/T1) Avail: NTIS HC/MF A02

The general objectives of this research have been to build a body of knowledge concerning cyclic and polycyclic organic hosts' ability to complex and lipophilize guest metal ions. The structures of the host ligating systems have been varied widely, and correlated with the rates of complexation-decomplexation; the free energies of binding; the selectivities of the hosts for the guests, and the guests for the hosts in binding. High selectivities have been observed by matching the stereoelectronic properties of the ligands to that of the metal ions (complementarity). The strength of binding has been regulated by the numbers and types of the host's ligating sites and, particularly, by the degree of preorganization of these sites for binding and low solvation (principle of preorganization). We have derived empirical correlations useful in the design and industrial application of new analytical reagents for measuring sodium and potassium ions in serum. DOE

**N91-32206#** Rochester Univ., NY. Lab. for Laser Energetics.
**DYNAMICS OF SURFACE MELTING**
H. E. Elsayed-Ali Jun. 1991 24 p
(Contract DE-FG02-88ER-45376)
(DE91-016344; DOE/ER-45376/3) Avail: NTIS HC/MF A03

The objective of this program is to study the phenomenon of surface disordering surface melting of single crystals of metals at temperatures below that of bulk melting. We use conventional static electron diffraction techniques as well as dynamic ultrafast reflection high-energy electron diffraction (RHEED) to study the temperature dependent surface structural behavior. Static RHEED experiments on surface disordering of Pb(110) crystal were conclusive on the existence of surface disordering at temperatures approximately 50 K below the bulk melting temperature. A large set of time-resolved RHEED experiments was conducted to study the thermal response of Pb(110) to approximately 150-ps pulsed laser heating. The surface Debye-Waller effect was used to time resolve the evolution of surface temperature. This provided a picosecond time-resolved surface lattice structure and temperature probe. Results for laser fluences below the surface disordering temperature show agreement with a heat diffusion model. For laser fluences above the surface disordering temperature, surface disorder upon heating and regrowth of crystalline order were observed to be completely reversible within approximately 150 ps. An extensive study of the temperature dependent surface disordering of Pb(100) using angle-resolved photoemission was conducted. Results show that the onset of surface disorder occurs at 586 K (plus or minus 5 K). The number of disordered layers grow logarithmically to approximately 4 to 5 monolayers at 599 K. Slight anisotropy, which favors disordering along the (011) azimuth compared to that along the (001) azimuth, was observed. DOE

**N91-32207#** Rochester Univ., NY. Lab. for Laser Energetics.
**PICOSECOND TIME-RESOLVED ELECTRON DIFFRACTION STUDIES OF LASER HEATED METALS**
H. E. Elsayed-Ali, J. W. Herman, and K. K. Lo 1990 9 p
Presented at the International Conference on Lasers '90, San Diego, CA, 10-14 Dec. 1990
(Contract DE-FG02-88ER-45376)
(DE91-016345; CONF-901263-10) Avail: NTIS HC/MF A02

Picosecond time-resolved high-energy electron diffraction is used as a lattice temperature probe of laser heated metal surfaces and thin films. A picosecond laser pulse is split into two beams. The first interacts with the sample. The second activates the cathode of an electron gun creating a collimated and focused electron pulse that is well synchronized with the heating laser pulse. The electron pulse is used to generate a reflection high-energy electron diffraction pattern of a surface or a transmission electron diffraction pattern of a thin film. Since heating results in an intensity reduction of the elastically scattered electrons (Debye-Waller effect), the diffraction patterns provide information on the lattice temperature as well as structure. Time-resolved surface temperature measurements show general agreement with that predicted by a heat diffusion model. DOE

**N91-32208#** Los Alamos National Lab., NM.
**THE NEW METALS AND ALLOYS COMPILATION, A POWERFUL MATERIALS ANALYSIS TOOL**
P. L. Wallace, L. D. Calvert, and T. C. Huang (International Business Machines Corp., San Jose, CA.) 1991 18 p Presented at the Pacific-International Congress on X Ray Analytical Methods, Honolulu, HI, 12-16 Aug. 1991
(Contract W-7405-eng-36)
(DE91-016199; LA-UR-91-2417; CONF-910862-2) Avail: NTIS HC/MF A03

A new compilation of Metals and Alloys indexes of powder diffraction and structural data has been completed. This compilation is designed to make characterization of metallic and related nonmetallic materials easier and more accurate. To achieve these goals, the existing Metals and Alloys Powder Diffraction File (M&A PDF) contents were greatly increased to make the M&A PDF contents similar to standard metallurgical references. Then six new indexes based on the M&A PDF were developed. DOE

**N91-32209#** Oak Ridge National Lab., TN.
**FUNDAMENTAL METALLURGICAL CONSIDERATIONS IN BRAZING AND SOLDERING**
M. Santella 1991 5 p Presented at the Fall Meeting of the Minerals, Metals, and Materials Society of AIME and Materials Week of the American Society of Metals, Cincinnati, OH, 20-24 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE91-016224; CONF-.1003-6) Avail: NTIS HC/MF A01

The ability to obtain braze or solder joints which are free of defects and have properties suitable for their intended applications depends directly on the phenomena of wetting and flow of liquid filler metals. Wetting in brazing and soldering is covered for both chemical non-equilibrium and equilibrium conditions. Filler material liquid flow is covered for both vertical joints and horizontal joints. DOE

**N91-32210#** California Univ., Berkeley. Lawrence Berkeley Lab.
**REACTION SINTERING OF ZnO-Al2O3 Ph.D. Thesis**
Wan-Shick Hong May 1991 72 p
(Contract DE-AC03-76SF-00098)
(DE91-016254; LBL-30832) Avail: NTIS HC/MF A04

The objectives of this study are: (1) to study the roles of densification kinetics and reaction kinetics and the relationship of the sintering stress to kinetics in a two-component system which undergoes both densification and chemical reaction; and (2) to evaluate the extent of the densification of this system by investigating the effects of the process variables on the overall sintering behavior. A model system was chosen based on the following criteria: a relatively simple phase relationship, well-studied reaction kinetics, non-hygroscopic, and sinterability in the existing equipment. The ZnO-Al2O3 system satisfies all of these conditions and the powders are commercially available. Particle size, heating rate, and initial density were chosen as process variables, and all of them were easily adjustable. DOE

**N91-32211#** Brookhaven National Lab., Upton, NY.
**PHOTON STIMULATED DESORPTION FROM ALUMINUM AND STAINLESS STEEL**
T. S. Chou 1990 11 p Presented at the 37th National American Vacuum Society Symposium, Toronto, Ontario, 8-12 Oct. 1990
(Contract DE-AC02-76CH-00016)
(DE91-017007; BNL-46468; CONF-901035-21) Avail: NTIS HC/MF A03

Photon Stimulated Desorption of neutral species (PSD) is the major dynamic gas load in electron synchrotron light source. In the National Synchrotron Light Source, (NSLS) PSD presented initial machine commissioning difficulty. Sensitivity to surface contamination on PSD has been experienced during an incident of Fomblin Oil contamination. U1OB-Photon Stimulated Desorption Experimental Station is constructed to investigate: (1) the degree of the contribution to the photon stimulated desorption (PSD) from primary photon flux and scattered secondary photon flux; (2) the underlying mechanism for photon stimulated desorption; (3) criteria to choose the proper beam tube material for future accelerators such as SXLS, FEL, SSC, ALS... In this report, only photon stimulated desorption of neutral species (PSD) from stainless steel and aluminum is reported. DOE

**N91-32212#** Pacific Northwest Lab., Richland, WA.
**IRRADIATION-INDUCED CHROMIUM DEPLETION AND ITS INFLUENCE ON INTEGRANULAR STRESS CORROSION CRACKING OF STAINLESS STEELS**
S. M. Bruemmer, L. A. Charlot, and E. P. Simonen Aug. 1991 10 p Presented at the 5th International Symposium on Environmental Degradation on Materials in Nuclear Power Systems, Water Reactors, Monterey, CA, 25-29 Aug. 1991
(Contracts DE-AC06-76RL-01830; DE-AC06-76RL-01831)
(DE91-017418; PNL-SA-19237; CONF-910808-4) Avail: NTIS HC/MF A02

Irradiation dose effects on grain boundary chromium depletion were quantified using analytical electron microscopy on fine grained, sputter deposited stainless steels. Damage levels up to 10 dpa were produced in near surface regions (encompassing several grain diameters in depth) by ion bombardment at 500 C. A sharp decrease in the grain boundary chromium concentration was observed with increasing dose until damage levels reached approx. 5 dpa. Chromium concentrations dropped from 18 wt pct. to approx. 10 wt pct. at 5 dpa, then remained nearly constant at higher dose. The width of the chromium depleted region increased with dose reaching about 8 nm at 5 dpa. Radiation induced chromium depletion was modeled by the inverse Kirkendall effect and was found to accurately predict experimental measurements on ion irradiated steels. Predictions were also consistent with the limited data rep ted on neutron irradiated materials. This fit of the model to ion irradiation measurements gives more credibility to predictions of expected depletion characteristics from in-core neutron exposures. Grain boundary chromium concentrations of approx. 10 wt pct. and depletion widths of approx. 4 nm are predicted after a neutron fluence (1 dpa) which is known to promote irradiation assisted stress corrosion cracking (IASCC). Similarities were noted between predicted depletion during ion irradiation at 500 C and during neutron irradiation at 288 C. Radiation induced chromium depletion profiles were simulated in 304SS by an iterative heat treatment sequence to produce very narrow concentration gradient with chromium minimums of approx. 11 wt pct. and depletion widths of 2, 5, 10, 20 and 50 nm. DOE

**N91-32213#** Argonne National Lab., IL.
**ELECTRONIC TRANSPORT PROPERTIES IN COPPER OXIDES**
J. H. Park and K. Natesan Jul. 1991 36 p
(Contract W-31-109-eng-38)
(DE91-018182; ANL-91/27) Avail: NTIS HC/MF A03

Oxidation of copper and electronic transport in thermally grown large grain polycrystals of nonstoichiometric copper oxides were studied at elevated temperatures. Thermogravimetric copper oxidation was studied in air and oxygen at temperatures between 350 and 100 C. From the temperature dependence of oxidation rates, three different processes can be identified for the oxidation of copper: bulk diffusion, grain boundary diffusion, and surface control with whisker growth; these occur at high, intermediate, and low temperatures, respectively. Electrical conductivity measurements as a function of temperature (350 to 1134 C) and pO2 (10(exp -8) 1.0 atm) indicated intrinsic electronic conduction in CuO over the entire range of conditions. Electronic behavior of nonstoichiometric Cu2O indicates that the charge defects are doubly ionized oxygen interstitials and holes. The calculated enthalpy of formation of oxygen (Delta HO2) and the hole conduction energy (E sub H) at constant composition for nonstoichiometric Cu2O are 2.0 (+ or -) 0.2 eV and 0.82 (+ or -) 0.02 eV, respectively. DOE

**N91-32214#** Oak Ridge National Lab., TN.
**ELECTRON ENERGIES IN METALS**
G. D. Mahan (Tennessee Univ., Knoxville.) 10 Jul. 1991 28 p

Presented at the Symposium on Electron Correlation, Trieste (Italy), 22 Jul. - 3 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE91-016759; CONF-9107158-1) Avail: NTIS HC/MF A03

The modern era of electron-electron interactions began a decade ago. Plummer's group initiated a program of using angular resolved photoemission to examine the band structure of the simple metals. Beginning with aluminum, and carrying on to sodium and potassium, they always found that the occupied energy bands were much narrower than expected. For example, the compressed energy bands for metallic potassium suggest a band effective mass of m* = 1.33 m sub e. This should be compared to the band mass found from optical conductivity m*/m sub e = 1.01 (+ or -) 0.01. The discrepancy between these results is startling. It was this great difference which started my group doing calculations. Our program was two-fold. On one hand, we reanalyzed the experimental data, in order to see if Plummer's result was an experimental artifact. On the other hand, we completely redid the electron-electron self-energy calculations for simple metals, using the most modern choices of local-field corrections and vertex corrections. Our results will be reported in these lectures. They can be summarized as following: Our calculations give the same effective masses as the older calculations, so the theory is relatively unchanged; Our analysis of the experiments suggests that the recent measurements of band narrowing are an experimental artifact. DOE

**N91-32215*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**THEORETICAL MODELLING OF AFM FOR BIMETALLIC TIP-SUBSTRATE INTERACTIONS**
Guillermo Bozzolo (Analex Corp., Brook Park, OH.) and John Ferrante Oct. 1991 17 p
(NASA-TM-105280; E-6585; NAS 1.15:105280) Avail: NTIS HC/MF A03 CSCL 11F

Recently, a new technique for calculating the defect energetics of alloys based on Equivalent Crystal Theory was developed. This new technique successfully predicts the bulk properties for binary alloys as well as segregation energies in the dilute limit. The authors apply this limit for the calculation of energy and force as a function of separation of an atomic force microscope (AFM) tip and substrate. The study was done for different combinations of tip and sample materials. The validity of the universality discovered for the same metal interfaces is examined for the case of different metal interactions. Author

**N91-32216*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**LUBRICATION WITH SPUTTERED MoS2 FILMS: PRINCIPLES, OPERATION, LIMITATIONS**
T. Spalvins 1991 15 p Proposed for presentation at the Advanced Surface Engineering and Technology Conference, Cincinnati, OH, 21-24 Oct. 1991; sponsored by the Surface Engineering Division of ASM International
(NASA-TM-105292; E-6573; NAS 1.15:105292) Avail: NTIS HC/MF A03 CSCL 11F

The present practices, limitations, and understanding of thin sputtered MoS2 films are reviewed. Sputtered MoS2 films can exhibit remarkable tribological properties such as ultralow friction coefficients (0.01) and enhanced wear lives (millions of cycles) when used in vacuum or dry air. To achieve these favorable tribological characteristics, the sputtering conditions during deposition must be optimized for adequate film adherence and appropriate structure (morphology) and composition. Author

**N91-32217*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**ELECTRODEPOSITED ZINC-NICKEL AS AN ALTERNATIVE TO CADMIUM PLATING FOR AEROSPACE APPLICATION**
V. C. McMillan Jul. 1991 16 p Original contains color illustrations
(NASA-TM-103551; NAS 1.15:103551) Avail: NTIS HC/MF A03; 5 functional color pages CSCL 11F

Corrosion evaluation studies were conducted on 4130 alloy steel samples coated with electrodeposited zinc-nickel and samples coated with electrodeposited cadmium. The zinc nickel was deposited by the selection electrochemical metallizing process. These coated samples were exposed to a 5-percent salt fog environment at 35 plus or minus 2 C for a period ranging from 96 to 240 hours. An evaluation of the effect of dichromate coatings on the performance of each plating was conducted. The protection afforded by platings with a dichromate seal was compared to platings without the seal. During the later stages of testing, deposit adhesion and the potential for hydrogen entrapment were also evaluated. Author

**N91-32218#** Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
**DEVELOPMENT OF A SPRAY-FORMING PROCESS FOR STEEL**
W. DuBroff, J. F. Key, N. J. Grant, T. Ando, V. K. Sikka, T. J. Huxford, and R. L. Heestand 12 Sep. 1990 109 p Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge and Oak Ridge National Lab., TN
(Contract DE-AC07-76ID-01570)
(DE91-015812; DOE/ID-10297) Avail: NTIS HC/MF A06

The principal objective of this program is to develop a near net-shape casting technology based on spray atomization and deposition for the production of low-carbon steel sheet and plate with estimated energy and cost savings of $20/t and $50/t, respectively. The properties produced with this process are generally equivalent or greater than that obtained with conventional continuous or ingot casting practices. Although the effort in this program is currently directed toward flat products, the technology has the flexibility to produce materials in a variety of thickness and shapes. Furthermore, enhanced versions of the technology will be able to produce high margin products, such as coated steel, in relatively few operations compared to the current flow sheet. The production of new materials, such as steel-based composites, is also possible with this technology. The combination of enhanced properties, new materials, and shaped products distinguishes the spray forming technology from all other near net-shape casting processes. The program is divided into three phases in which the technology moves from the bench-scale (Phase 1) to pilot-scale (Phase 2) and commercial-scale (Phase 3). This report summarizes the activities at three laboratories during the second half of the first year of the two year Phase 1 program. DOE

**N91-32219#** Sandia National Labs., Albuquerque, NM.
**THE ROLE OF ANODIC DISSOLUTION IN THE STRESS CORROSION CRACKING OF Al-Li-Cu ALLOY 2090**
R. G. Buchheit, Jr., F. D. Wall, G. E. Stoner, and J. P. Moran (Aluminum Co. of America, Alcoa Center, PA.) 1991 15 p Presented at the 1st Symposium on Environmental Effects of Advanced Materials, San Diego, CA, 19-21 Jun. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016403; SAND-91-0840C; CONF-9106145-2) Avail: NTIS HC/MF A03

The short-transverse (S-T) stress corrosion cracking (SCC) behavior of Al-Li-Cu alloy 2090 was studied using a static load SCC test technique. Time to failure was measured as a function of applied potential in several different environments. Rapid SCC failures (less than 10 hours) were observed only when the following criteria were satisfied: E sub (br, T1) less than E sub applied less than E sub (br, matrix) where potentials refer to the breakaway potentials of the subgrain boundary T sub 1 (Al2CuLi) phase and the alpha-Al matrix phase. The E sub br values were measured using potentiodynamic polarization of bulk materials intended to simulate the individual phases found in the subgrain boundary region. Results strongly suggest an anodic dissolution based SCC mechanism for this alloy where selective dissolution of T sub 1 on the subgrain boundary is a critical step. The unusual pre-exposure embrittlement phenomenon demonstrated by Al-Li alloys is also shown to be consistent with these simple SCC criteria. DOE

**N91-32220#** Oak Ridge National Lab., TN.
**ORDERING ENERGY OF B2 ALLOYS CALCULATED IN THE FROZEN POTENTIAL AND HARRIS APPROXIMATIONS**
W. A. Shelton, D. M. Nicholoson, G. M. Stocks, F. J. Pinski, D. D. Johnson, and P. A. Sterne (Lawrence Livermore National Lab., CA.) 1990 10 p Presented at the Spring Meeting of the Materials Research Society (MRS), San Francisco, CA, 16-21 Apr. 1990
(Contracts DE-AC05-84OR-21400; W-7405-eng-48; DE-AC04-76DP-00789)
(DE91-017228; CONF-900466-101) Avail: NTIS HC/MF A02

It has been established that the coherent potential approximation can successfully describe the energy of random alloys. It has also served as the basis of generalized perturbation method and concentration wave calculations of the energy of short range ordered alloys. The multisublattice coherent potential, (MCPA) is the natural extension of the CPA with which to address long range order (LRO). Using the recently developed multisublattice coherent potential approximation Korringa Kohn Rostoker, (MCPA-KKR) code the eigenvalue sum can be calculated as a function of LRO. This allows the evaluation of the ordering energy by either or two approximations. The frozen potential approximation (FPA) assumes that the muffintin single site potentials do not change as the long range order is varied; the Harris Approximation, (HA) as applied in this work, assumes that the single site charge densities do not change as the long range order is changed. These two methods of calculating the ordering energy will be compared with each other and to experiment for several systems including CuZn, NiAl, and NiAl with zinc additions. DOE

**N91-32640*#** Sandia National Labs., Albuquerque, NM.
**DAMAGE TO METALLIC SAMPLES PRODUCED BY MEASURED LIGHTNING CURRENTS**
Richard J. Fisher and George H. Schnetzer *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced as N91-18565 Sponsored in part by Army (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 11F

**N91-32644*#** Federal Armed Forces Univ., Munich (Germany, F.R.)
**SIMULATION AND MEASUREMENT OF MELTING EFFECTS ON METAL SHEETS CAUSED BY DIRECT LIGHTNING STRIKES**
Alexander Kern (Universitaet der Bundeswehr Muenchen, Neubiberg, Germany, F.R. ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 11F

# 27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

**N91-32221*#** Alabama Univ., Huntsville. Center for Applied Optics.
**POLARIZATION EFFECTS, TASKS 3 AND 4 Final Report**
H. M. Jaenisch 16 Aug. 1990 76 p
(Contract NAS8-36955)
(NASA-CR-184219; NAS 1.26:184219) Avail: NTIS HC/MF A05

The LP-140 is a commercial pulsed CO2 laser system. An attempt was made to convert this workhorse laser into a device suitable for coherent LIDAR applications. This required initial laser characterization, and system modification. The key changes which enabled the laser to display encouraging characteristics are: increased cavity length; increased gas flow; gas mixture modification; and power supply redesign. With suitable modifications, the LP-140 becomes a viable candidate for a coherent LIDAR. Author

**N91-32222#** Oak Ridge National Lab., TN.
**HEAT TRANSFER EFFECTIVENESS OF A THERMAL BARRIER COATING WITH DIFFERENT FUEL COMPOSITIONS**
N. Domingo Jun. 1991 38 p
(Contract DE-AC05-84OR-21400)
(DE91-015602; ORNL/TM-11816) Avail: NTIS HC/MF A03

Experiments were conducted to determine the heat transfer effectiveness of a plasma-sprayed, partially stabilized, zirconia coating when heated by a non-luminous, less radiant flame (methane/air) and a luminous flame (n-butane/air). Composite thermal conductances (combined conductive and radiative resistance) are reported for a 0.5 mm thick ceramic coating at a given heat flux and coating mean temperature. A novel laser fluorescence thermometry technique, which has been shown to be independent of flame thermal radiation background and surface emissivity, was used to measure coating surface temperature. Without reheating, the results showed that the thermal conductance decreased by 66 pct. with temperature within the range of 170 to 240 C. For n-butane flame heating, the thermal conductance decreased by 54 pct. over a very narrow temperature range. Reheating of the coating produced an apparent irreversible change in its thermal conductance. Initial values for thermal conductance decreased by 30 pct. following reheat. DOE

**N91-32223#** Construcciones Aeronauticas S.A., Madrid (Spain). Subdireccion de Investigacion y Desarrollo de Tecnologia y Materiales.
**RESISTANCE OF PERISHED PAINTS TO SKYDROL [RESISTENCIA A SKYDROL DE PINTURAS DE ACABADO (A-320)]**
1990 9 p In SPANISH
(Informe-I-536/90; ETN-91-90060) Avail: NTIS HC/MF A02

Problems appearing in the paint work of the A-320 Airbus landing gear, due to the high temperature projection of Skydrol (trademark) produced in this region, are addressed. A test to introduce changes in the paintwork of the parts to improve resistance to this hydraulic fluid is proposed. ESA

**N91-32224#** Department of the Navy, Washington, DC.
**SILVER LINED CERAMIC VESSEL AND METHOD OF PREPARATION Patent Application**
William A. Ferrando, inventor (to Navy), Amarnath P. DiVecha, inventor (to Navy), and James Kerr, inventor (to Navy) 10 May 1991 9 p
(AD-D014953; US-Patent-Appl-SN-700375) Avail: NTIS HC/MF A02 CSCL 11/2

This invention relates to reaction vessels and more particularly high temperature reaction vessels having inert metal surfaces. Many of the component elements, oxides and nitrates used in synthesizing high temperature superconductor (HTS) compounds (and perhaps other classes of compounds) tend to react with most containment vessels during the high temperature processing required to form or sinter the materials. The noble metals are the only materials which remain essentially non-reactive under the required processing conditions. The noble metals (gold and silver) have been shown to protect the HTS compounds during thermal treatment and impart beneficial properties as additives. In achieving the purity of final HTS product necessary for high transport current, introduction of second phases during heat treatment must be minimized. GRA

**N91-32225*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**LEACHING BEHAVIOR OF MICROTEKTITE GLASS COMPOSITIONS IN SEA WATER AND THE EFFECT OF PRECIPITATION ON GLASS LEACHING**
1991 32 p
(Contract DE-AI09-80ET-47927)

(NASA-TM-105106; NAS 1.15:105106; DE91-016413; DOE/ET-47927/T6) Avail: NTIS HC/MF A03 CSCL 11B

The present study attempts to account for the slow corrosion rates of microtektite glass in nature by comparing the leach rates of synthetic microtektite glass samples in deionized water and in sea-water, respectively. In order to obtain systematic data about leachant composition effects, leach tests were also carried out with synthetic leachant compositions enriched with respect to silica or depleted with respect to certain major components of sea-water (Mg, Ca). DOE

**N91-32226#** Allied-Signal Aerospace Co., Kansas City, MO.
**SURFACE MODIFICATION OF HIGH-STRENGTH REINFORCING FIBERS BY PLASMA TREATMENT**
M. D. Smith Jul. 1991 79 p
(Contract DE-AC04-76DP-00613)
(DE91-016481; KCP-613-4369) Avail: NTIS HC/MF A05

Allied-Signal Inc., Kansas City Division, has, for several years, used plasma treatments to dry, activate, and clean polymeric surfaces to provide enhanced adhesive bonding. Work in this area generated positive expectations regarding the plasma treatment of fibers. Gas plasma treatment of fibers, prior to impregnation with epoxy resin, was anticipated to yield significantly higher bond strengths between fibers or layers of fibers in a wet lay-up composite. This project tested the effects of plasma treatment on polyaramid, polyethylene, and graphite fibers. A continuous plasma treatment unit and a filament winder were used to treat the fibers and then wrap them into T-peel specimens for testing. Significant increases in resin-to-fiber bond strength were demonstrated for polyaramid and polyethylene fibers. Increases in T-peel strength of 200 to 500 percent over untreated fiber were the norm for those plasma-treated fibers. Graphite fibers showed some improvement in bond strength by plasma treatment, although the increases were not as significant as with the other two fibers. Future work in this area includes a new project now underway. The purpose of that project is to characterize and evaluate product applications for continuous plasma treatment and resin impregnation of high-strength reinforcing fibers including tapes, straps, and woven fabrics made of those fibers. DOE

**N91-32227#** Lawrence Livermore National Lab., CA.
**THERMAL-MECHANICAL AND PHYSICAL-CHEMICAL PROPERTIES OF PHOSPHATE LASER GLASSES**
M. L. Elder, J. H. Campbell, S. A. Payne, G. D. Wilke, and Y. T. Hayden (Schott Glass Technologies, Inc., Duryea, PA.) 12 Jul. 1991 24 p Presented at the 93rd Annual Meeting and Exposition of the American Ceramic Society (ACerS), Cincinnati, OH, 28 Apr. - 2 May 1991
(Contract W-7405-eng-48)
(DE91-016604; UCRL-JC-105474; CONF-910430-18) Avail: NTIS HC/MF A03

A compositional study of the effects of various network formers on the physical properties of phosphate laser glasses used in fusion research lasers is reported. The network formers include P2O5, Al2O3, SiO2, and B2O3 and most glass compositions are metaphosphates or near-ultraphosphates. We have chosen Schott's commercial LG-750 laser glass as a reference composition. The results show that laser glasses having improved physical properties compared to LG-750 can be prepared by decreasing the Al2O3 and increasing the P2O5 content. Figures-of-merit are used to characterize the relative improvements of the various glasses studied. DOE

**N91-32228#** Oak Ridge National Lab., TN.
**ADVANCES IN THE DESIGN OF TOUGHENED CERAMICS**
P. F. Becher 1991 18 p Presented at the International Symposium on Ceramics, Yokohama (Japan), 16-18 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE91-016767; CONF-911084-2) Avail: NTIS HC/MF A03

The mechanical performance of brittle ceramics can be improved by increasing their fracture toughness/resistance. This is reflected by increases in resistance to strength degradation from in-service thermal stresses, slow crack growth, and contact or impact damage when the fracture toughness is enhanced. Furthermore, it appears that the distribution of the fracture strengths is narrowed (e.g., increased Weibull modulus) in toughened ceramics. Two approaches which can result in improved fracture toughness are transformation toughening and reinforcement processes. The reinforcement process can be achieved by introducing various microstructural features (e.g., strong whiskers and platelets, large noncubic matrix grains, and elongated matrix grains). However, the design of toughened ceramics employing either transformation toughening or reinforcement mechanisms must consider the material properties and characteristics which control each mechanism. Both the analysis of the toughening contributions and experimental observations can be used to define the influence of microstructure and material parameters on the toughening effects. These observations, then, provide a basis for the design of toughened ceramics. DOE

**N91-32229*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**CERAMIC COATINGS ON SMOOTH SURFACES Patent Application**
R. A. Miller, inventor (to NASA), W. J. Brindley, inventor (to NASA), and C. J. Rouge, inventor (to NASA) 26 Sep. 1991 11 p
(NASA-Case-LEW-15164-2; NAS 1.71:LEW-15164-2; US-Patent-Appl-SN-766591) Avail: NTIS HC/MF A03 CSCL 11C

A metal substrate or a bond coating having a smooth surface is covered by a thin ceramic layer of ZrO2 - 8 pct. Y2O3 having a thickness between 0.6 and 1.9 mils. A second ceramic layer of ZrO2 - 8 pct. Y2O3 having a thickness between about four and 15 mils covers the thin ceramic layer. NASA

**N91-32230*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**ADDITION POLYIMIDES WITH ENHANCED PROCESSABILITY Patent Application**
Chun-Hua Chuang, inventor (to NASA) and Raymond D. Vannucci, inventor (to NASA) 7 Oct. 1991 18 p
(NASA-Case-LEW-15043-1; NAS 1.71:LEW-15043-1; US-Patent-Appl-SN-772181) Avail: NTIS HC/MF A03 CSCL 11C

The present invention is directed to nonplanar polyimides having improved thermo-oxidative stability and enhanced processability. In a preferred embodiment, high molecular weight polyimides (HMW PMRs (polymerization of monomer reactants)) are obtained by reacting a nonplanar polyphenyl diamine, a diester or dianhydride of a tetracarboxylic acid, and an end capping compound. A second embodiment involves reacting a diamine with a nonplanar diester, or nonplanar dianhydride, of a tetracarboxylic acid, and an end capping compound. The polyimides of this invention overcome processing difficulties involved with using HMW PMRs through their noncoplanar conformation. For example, the noncoplanar conformation helps reduce the melting temperature and melt viscosity normally required and thereby permits substantially increased resin flow in processing of HMW PMRs. The polyimides of the invention possess excellent thermo-oxidative stability at 343 to 371 C for composite applications. In addition, the polyimides of the invention display a low thermal expansion coefficient and a narrow molecular weight distribution at high molecular weights. NASA

**N91-32231*#** Boeing Aerospace and Electronics Co., Seattle, WA.
**ADVANCED THERMOPLASTIC RESINS, PHASE 2 Final Report**
A. M. Brown, S. G. Hill, and A. Falcone Sep. 1991 136 p
(Contract NAS1-17432)
(NASA-CR-187548; NAS 1.26:187548; D180-32725-2) Avail: NTIS HC/MF A07 CSCL 11C

High temperature structural resins are required for use on advanced aerospace vehicles as adhesives and composite matrices. NASA-Langley developed polyimide resins were evaluated as high temperature structural adhesives for metal to metal bonding and as composite matrices. Adhesive tapes were

prepared on glass scrim fabric from solutions of polyamide acids of the semicrystalline polyimide LARC-CPI, developed at the NASA-Langley Research Center. Using 6Al-4V titanium adherends, high lap shear bond strengths were obtained at ambient temperature (45.2 MPa, 6550 psi) and acceptable strengths were obtained at elevated temperature (14.0 MPa, 2030 psi) using the Pasa-Jell 107 conversion coating on the titanium and a bonding pressure of 1.38 MPa (200 psi). Average zero degree composite tensile and compressive strengths of 1290 MPa (187 ksi) and 883 MPa (128 ksi) respectively were obtained at ambient temperature with unsized AS-4 carbon fiber reinforcement.

Author

**N91-32232#** Argonne National Lab., IL.
**MATERIALS QUALIFICATION TECHNOLOGY FOR CERAMIC CROSS-FLOW FILTERS**
J. P. Singh, S. Majumdar, A. S. Wagh, T. Wenzel, and R. B. Poeppel Jul. 1991 42 p
(Contract W-31-109-eng-38)
(DE91-017715; ANL/FE-91/1) Avail: NTIS HC/MF A03

The physical, mechanical, and microstructural properties of ceramic cross-flow filters in as-fabricated condition (Filter A) and after exposure to a gasifier environment (Filter B) were studied. The filters contain mullite as the major phase and are approximately 41 percent porous. The pore size varies from submicron to 112 microns, and this distribution broadens upon exposure to a gasifier environment. Stress and fracture mechanics analyses were completed and the property data, together with stress and fracture mechanic analyses, were used to determine probable cause(s) of failure. Static and dynamic finite-element stresses on the filter were analyzed during a pulse-cleaning cycle, using a micro-model (considering the details of the gas channels) and a macro-model (ignoring the details of the gas channels). Fracture mechanics analyses of the micro model with pre-existing cracks of various lengths at the channel corners were also carried out. Near coincidences of the calculated and measured (Westinghouse) frequencies during pulse-cleaning provided strong evidence for narrow contact between the clamp and the free end of the flange. The analyses suggested that, to minimize the maximum stresses in the filter, such a linear contact between the clamp and the flange should be avoided. The pressure-induced stresses during phase-cleaning were small. However, based on a transient thermal analysis, the transient thermal stresses in the filter could be high.

DOE

**N91-32233#** Sandia National Labs., Albuquerque, NM.
**SHOCK-VAPORIZATION STUDIES ON ZINC AND POROUS CARBON**
J. L. Wise, G. I. Kerley, and T. G. Trucano 1991 4 p Presented at the 1991 American Physical Society (APS) Conference on Shock Compression of Condensed Matter, Williamsburg, VA, 17-20 Jul. 1991
(Contract DE-AC04-76DP-00789)
(DE91-017846; SAND-91-0041C; CONF-9107105-50) Avail: NTIS HC/MF A01

Experiments probing the shock-induced vaporization of zinc and porous carbon yielded time-resolved data suitable for evaluation of equation-of-state (EOS) models and computations that describe expanded-state material behavior. In these tests, partial vaporization of the target material occurred as the initial shock stress (approximately greater than or = 100 GPa) was released through a rarefaction originating at the target free surface. The target expansion products traversed a gap and impinged on a witness plate that was backed by a transparent window. A velocity interferometer recorded histories of the witness-plate/window interface velocity which were compared to one-dimensional wavecode (CTH) calculations based on selected multiphase EOS treatments.

DOE

**N91-32234#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Structures and Mechanisms Div.
**ADHESIVE BONDING HANDBOOK FOR ADVANCED STRUCTURAL MATERIALS**
Feb. 1990 225 p
(ESA-PSS-03-210-Issue-1; ISSN-0379-4059; ETN-91-90071)
Copyright Avail: NTIS HC/MF A10

Adhesive bonding is a viable method of joining advanced composite materials and certain metals which are used in the aerospace industries. When desiging a joint, a whole range of factors which have a direct influence on the materials selection, manufacture and inspection activities, need to be considered. It is therefore necessary to follow a fully integrated program to ensure joint integrity. The aim of this handbook is to highlight what needs to be known, and identify what and where relevant information is available for the existing range of adhesives and the materials most commonly used in spacecraft structures. The state of technology for the merging materials which have potential for use in future European space projects is reviewed.

ESA

**N91-32309#** MATRA Espace, Paris-Velizy (France). Microelectronics and Packaging Depts.
**SURFACE MOUNT ON CERAMIC: HOW TO ACHIEVE A SPACE QUALITY LEVEL**
Michel Massenat *In* ESA, ESA Electronic Components Conference Mar. 1991 p 127-132 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32321#** Selenia Spazio S.p.A., Rome (Italy).
**THE ROLE OF PHOTOSENSITIVE POLYIMIDES IN THE DEVELOPMENT OF HYBRID SPACE HARDWARE**
U. DiMarcantonio and R. Cirone *In* ESA, ESA Electronic Components Conference Mar. 1991 p 187-192 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

# 28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

**N91-32235#** Southern California Research Corp., San Rafael.
**NATURAL GAS CONVERSION PROCESS Quarterly Report No. 3**
1991 5 p
(Contract DE-FG01-90CE-15459)
(DE91-015759; DOE/CE-15459/T3) Avail: NTIS HC/MF A01

The main objective is to design and operate a laboratory apparatus for the catalytic reforming of natural gas in order to provide data for a large scale process. To accelerate the assembly and calibration of this equipment, a request has been made to the Lawrence Berkeley Laboratory for assistance, under the DOE's Industrial Visitor Exchange Program. Pr. Heinz Heinemann (Catalysis), Dr. John Apps (Geochemistry) and Dr. Robert Fulton (Mechanical Engineering) have expressed interest in supporting our request. Pr. Heinemann's recent results on the conversion of Petroleum Coke residues into CO2 and H2 mixtures using highly basic metal oxides catalysts, similar to ours, are very encouraging regarding the possibility of converting the Coke residue on our catalyst into Syngas in the Regenerator/riser, as proposed. To minimize Coke formation in the vapor phase, by the Plasmapyrolytic Methane Conversion reactions, the experimental data of H. Drost et al. (Ref. 12) have been reviewed. Work is underway to design equipment for the safe and nonpolluting disposal of the two gaseous product streams of the flow loop.

DOE

# 29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

**N91-32236*#** Alabama Univ., Huntsville.
**MICROGRAVITY LIQUID PROPELLANT MANAGEMENT Final Report**
R. J. Hung Oct. 1990 181 p
(Contract NAS8-36955)
(NASA-CR-184238; NAS 1.26:184238) Avail: NTIS HC/MF A09 CSCL 22A

The requirement to settle or to position liquid fluid over the outlet end of a spacecraft propellant tank prior to main engine restart, poses a microgravity fluid behavior problem. Resettlement or reorientation of liquid propellant can be accomplished by providing optimal acceleration to the spacecraft such that the propellant is reoriented over the tank outlet without any vapor entrainment, any excessive geysering, or any other undersirable fluid motion for the space fluid management under microgravity environment. The most efficient technique is studied for propellant resettling through the minimization of propellant usage and weight penalties. Both full scale and subscale liquid propellant tank of Space Transfer Vehicle were used to simulate flow profiles for liquid hydrogen reorientation over the tank outlet. In subscale simulation, both constant and impulsive resettling acceleration were used to simulate the liquid flow reorientation. Comparisons between the constant reverse gravity acceleration and impulsive reverse gravity acceleration to be used for activation of propellant resettlement shows that impulsive reverse gravity thrust is superior to constant reverse gravity thrust. Author

# 31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

**N91-32237*#** Kent State Univ., OH. School of Technology.
**VERSATILE, LOW-COST, COMPUTER-CONTROLLED, SAMPLE POSITIONING SYSTEM FOR VACUUM APPLICATIONS Final Report**
Carlos Vargas-Aburto and Dale R. Liff Aug. 1991 25 p
(Grant NAG3-946)
(NASA-CR-187144; E-6308; NAS 1.26:187144) Avail: NTIS HC/MF A03 CSCL 14B

A versatile, low-cost, easy to implement, microprocessor-based motorized positioning system (MPS) suitable for accurate sample manipulation in a Second Ion Mass Spectrometry (SIMS) system, and for other ultra-high vacuum (UHV) applications was designed and built at NASA LeRC. The system can be operated manually or under computer control. In the latter case, local, as well as remote operation is possible via the IEEE-488 bus. The position of the sample can be controlled in three linear orthogonal and one angular coordinates. Author

**N91-32238#** Lawrence Livermore National Lab., CA.
**PRESSURE SAFETY TRAINING**
C. V. Borzileri Mar. 1991 183 p
(Contract W-7405-eng-48)
(DE91-015717; LLNL-M-089-Rev-8) Avail: NTIS HC/MF A09

This is the workbook for the Pressure Safety Training Course. It is intended as a reference manual and guide for all work with pressurized liquids or gases. This workbook contains basic references to make work with pressure safer. It is intended to supplement classroom instruction, rather than serve as a definitive text on pressure. Earlier versions of the manual were intended specifically for training at Lawrence Livermore National Laboratory (LLNL). This revision is a generic version intended for training at all DOE facilities. The information in the Standards chapter is from the LLNL Health and Safety Manual. It is included here as a convenient reference and guide for developing similar standards at your own facility. DOE

**N91-32239#** Oak Ridge National Lab., TN.
**BRAUN HEAT PUMP ENGINE/COMPRESSOR AND ITS HERMETIC ROD SEAL**
A. T. Braun, M. S. Alam, and R. J. Fiskum (Department of Energy, Washington, DC.) 1991 7 p Presented at the 26th Intersociety Energy Conversion Engineering (IECE) Conference, Boston, MA, 3-9 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017151; CONF-910801-17) Avail: NTIS HC/MF A02

A number of new developments in gas fired heat pump technology have evolved over the past several years which show promise for significant improvement in energy conversion efficiency. A major development in a gas fired heat pump and its seal is described, some recent results presented and suggestions made for areas where future advances may be made. DOE

**N91-32240*** National Aeronautics and Space Administration. Pasadena Office, CA.
**METHOD AND APPARATUS FOR PRODUCING MICROSHELLS Patent**
Mark C. Lee, inventor (to NASA), Christopher H. Schilling, inventor (to NASA), and Taylor G. Wang, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 8 Oct. 1991 7 p Filed 30 Apr. 1986
(NASA-Case-NPO-16635-1-CU; US-Patent-5,055,240; US-Patent-Appl-SN-858054; US-Patent-Class-264-5; US-Patent-Class-65-21.4; US-Patent-Class-75-331; US Patent-Class-75-338; US-Patent-Class-75-340; US-Patent-Class-75-342; US-Patent-Class-264-12) Avail: US Patent and Trademark Office CSCL 13H

A method is described for forming hollow particles, or shells, of extremely small size. The shell material is heated to a molten temperature in the presence of a gas that is at least moderately soluble in the shell material, to form a solution of the molten shell material and the soluble gas. The solution is atomized to form a multiplicity of separate droplets that are cooled while in free fall. Cooling of a droplet from the outside traps the desolved gas and forces it to form a gas bubble at the center of the droplet which now forms a gas filled shell. The shell is reheated and then cooled in free fall, in an environment having a lower pressure than the gas pressure in the shell. This causes expansion of the shell and the formation of a shell having a small wall thickness compared to its diameter.
Official Gazette of the U.S. Patent and Trademark Office

**N91-32731*#** Lightning Eliminators Co., Inc., Boulder, CO.
**ADVANCES IN LIGHTNING PROTECTION THAT SATISFIES CONTEMPORARY STANDARDS**
Roy B. Carpenter, Jr. *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 8 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 13B

**N91-32732*#** Electromer Corp., Belmont, CA.
**CIRCUIT PROTECTION DEVICES FOR TRANSIENT SUPPRESSION**
Richard Childers *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 13B

**N91-32733*#** Electro Magnetic Applications, Inc., Lakewood, CO.
**EVALUATING LIGHTNING HAZARDS TO BUILDING ENVIRONMENTS USING EXPLICIT NUMERICAL SOLUTIONS OF MAXWELL'S EQUATIONS**
Richard S. Collier, Paul M. McKenna, and Rodney A. Perala *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693

24-47)
(Contract DAAA21-89-C-0176)
Avail: NTIS HC/MF A20 CSCL 13B

**N91-32735*#** Communications and Weather Research Foundation, Jacksonville, FL.
**GUIDELINES FOR A PROPOSED LIGHTNING PROTECTION POLICY OF A GOLF ASSOCIATION OR TOURNAMENT SPONSOR**
Charles C. Hillyer *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 7 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 13B

# 32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

**N91-32241#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.
**PROPAGATION LIMITATIONS FOR SYSTEMS USING BAND-SPREADING**
C. Goutelard, ed. 1990 180 p Lecture Series held in Issy-les-Moulineaux, France, 7-8 Jun. 1990; also held in Rome, Italy, 11-12 Jun. 1990; and at Hanscom AFB, MA, 19-20 Jun. 1990; sponsored in part by the Consultant and Exchange Program
(AGARD-LS-172; ISBN-92-835-0569-7) Copyright Avail: NTIS HC/MF A09; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The use of spread spectrum signals in telecoms, detection, and remote sensing boosts system performance, ensures greater discretion, and improves ruggedness. State-of-the-art signal processing and the latest advances in processor technology use sophisticated techniques which point the way to new systems. The phenomena linked to propagation, noise and channel jamming, which limit performance, is examined together with procedures which either use or combat their effects. For individual titles, see N91-32242 through N91-32244.

**N91-32242#** Kaiserslautern Univ. (Germany, F.R.). Lehrstuhl fuer Hochfrequente Signaluebertragung und -Verarbeitung.
**WIDE BAND SYSTEMS**
Paul Walter Baier and Werner Kleinhempel *In* AGARD, Propagation Limitations for Systems Using Band-Spreading 1990 20 p (For primary document see N91-32241 24-32)
Copyright Avail: NTIS HC/MF A09; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Most radio communication systems being presently introduced are digital systems. Depending on the transmission bandwidth relative to the information rate, such systems can be divided into the class of narrow band systems and wide band systems. The advantages that wide band systems offer under adverse propagation conditions are studied. After introducing digital information transmission, digital wide band systems are defined on the basis of the used transmission signal forms and are compared with narrow band systems. The need for the application of wide band systems is pointed out referring to information theory, with the resistance against noise and interference as well as the capabilities of multiple access and selective addressing being addressed. Different types of wide band systems including spread spectrum are presented. The quantitative treatment of propagation problems in narrow band and wide band systems due to time variant multipath propagation is tackled and the potential of wide band systems in combatting propagation effects is shown. It is explained that properly designed spread spectrum systems are less affected by multipath reception than narrow band systems.
Author

**N91-32243#** Universite Catholique de Louvain (Belgium).
**PROPAGATION LIMITATIONS FOR TRANSIONOSPHERIC SYSTEMS FROM 10 TO 300 GHz**
A. VanderVorst and D. Vanhoenacker *In* AGARD, Propagation Limitations for Systems Using Band-Spreading 1990 19 p (For primary document see N91-32241 24-32)
Copyright Avail: NTIS HC/MF A09; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Broadband characterization of the transionospheric propagation channel requires a study of physical phenomena which are often neglected, and, in particular, the frequency dependence of the parameters of the link. It may be due to water vapor, liquid water, and time dependent inhomogeneities. The 10 to 100 GHz band is studied with an emphasis on the 20 to 30 GHz band, and some indications for higher frequencies. Atmospheric turbulence is especially looked at, because it yields fluctuations of the refractive index, leading to amplitude, phase, and angle of arrival variations on the signal. A model developed is presented. It takes into account the various parameters of the link: frequency, dielectric constant, losses, antenna diameter, inhomogeneity size, and altitude. The influence on actual signals is discussed, as well as frequency response, impulse and step response, and group delay. Author

**N91-32244#** Manchester Coll. of Science and Technology (England).
**HF SYSTEMS OPERATING BENEATH THE IONOSPHERE**
G. F. Gott and E. D. R. Shearman (Birmingham Univ., England ) *In* AGARD, Propagation Limitations for Systems Using Band-Spreading 1990 27 p Sponsored in part by Ministry of Defence and Science Research Council (For primary document see N91-32241 24-32)
Copyright Avail: NTIS HC/MF A09; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The features of HF terrestrial and aeromobile wideband systems, all of which use ionospheric propagation or are interfered with by ionospherically propagated signals, are outlined. These systems include radio communication (predominantly digital), and HF radar. The properties which limit ionospheric propagation are discussed and their implications for systems illustrated by means of the scattering function and sweep frequency sounding data. Other problems of the ionospheric channel are atmospheric and man made noise, and spectral occupancy. Noise is briefly reviewed, but special attention is given to spectral occupancy, with the inclusion of measured statistics and a mathematical model. Examples are given of wideband communication systems using frequency hopping and chirp signals. The measures which can be taken to sustain operation in severe spectral congestion are illustrated. The rather different requirements of HF radar systems, both sky wave and ground wave, which demand the achievement of very wide dynamic range and Doppler discrimination, are also outlined and illustrated. Author

**N91-32245** Syracuse Univ., NY.
**IMPROVEMENT IN RADAR DETECTION UNDER SCAN-TO-SCAN PROCESSING AND SCAN RATE REDUCTION**
**Ph.D. Thesis**
Joon Song 1990 325 p
Avail: Univ. Microfilms Order No. DA9119438

Recent advances in signal processing technology have resulted in a significantly greater computational capability at lower cost. As a result, many studies are currently underway to determine how increased signal processing can be used to improve the detection performance of existing radars without requiring major equipment modifications. Two approaches are examined: scan to scan processing (SSP) also known as track before detect (TBD); and the other involves scan rate reduction along with efficient post detection integration. Detailed analyses are carried out for the two methods. After a description of an existing radar, considerations

involved in a performance comparison of the baseline with the modified radar configurations are carefully explained. The baseline radar configuration is then modified by incorporating two different versions of SSP: for each case, an analysis is carried out to relate cell false alarm probabilities to system false alarm rate. In an effort to overcome the limitations encountered, an alternate approach is explored which involves scan rate reduction. Finally, an alternate approach is suggested to recent works on optimum detection in non-Gaussian clutter. Dissert. Abstr.

**N91-32246** Physics and Electronics Lab. TNO, The Hague (Netherlands).
**CARPET: A VERSATILE PROGRAM FOR RADAR PERFORMANCE ANALYSIS Final Report**
A. G. Huizing and A. Theil Feb. 1991 136 p
(FEL-91-B002; TD-91-0412; ETN-91-90001) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG, The Hague, Netherlands

The Computer Aided Radar Performance Evaluation Tool (CARPET) is a comprehensive computer program which alleviates the difficult task of designing and evaluating surface based radar systems. The program runs on IBM personal computers and compatibles under versions of DOS 3.0 and higher. The CARPET considers the entire radar system and its envrionment: emitter and receiver characteristics, clutter, jamming, and propagation phenomena. The program produces diagrams which are particularly useful in assessing the detection performance of a radar system. The features, capabilities, and the underlying models of CARPET are discussed. Some graphical examples of the output of CARPET are presented. ESA

**N91-32247*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**DATA COMPRESSION FOR FULL MOTION VIDEO TRANSMISSION**
Wayne A. Whyte, Jr. and Khalid Sayood (Nebraska Univ., Lincoln.) Sep. 1991 11 p Presented at the Conference on Advanced Space Exploration Initiative Technologies, Cleveland, OH, 4-6 Sep. 1991, cosponsored by the AIAA, NASA, and OAI
(NASA-TM-105239; E-6564; NAS 1.15:105239; AIAA-91-3533)
Avail: NTIS HC/MF A03 CSCL 17B

Clearly transmission of visual information will be a major, if not dominant, factor in determining the requirements for, and assessing the performance of the Space Exploration Initiative (SEI) communications systems. Projected image/video requirements which are currently anticipated for SEI mission scenarios are presented. Based on this information and projected link performance figures, the image/video data compression requirements which would allow link closure are identified. Finally several approaches which could satisfy some of the compression requirements are presented and possible future approaches which show promise for more substantial compression performance improvement are discussed. Author

**N91-32248** National Physical Lab., Teddington (England). Div. of Mechanical and Optical Metrology.
**REPORT ON THE PHOTOGRAMMETRIC DETERMINATION OF THE SHAPE OF A 10m DIAMETER MICROWAVE ANTENNA**
S. Brown and S. Oldfield Apr. 1991 50 p Original contains color illustrations
(NPL-MOM-103; ISSN-0309-3069; ETN-91-99863) Copyright
Avail: National Physical Lab., Teddington, Middlesex TW11 OLW, England

Photogrammetry is a noncontacting optical technique for measuring the form of three dimensional structures. Information about the structure is captured by recording photographs from different camera postions. Then, for any point on the structure which is recorded on more than one photograph, its three dimensional coordinates in object space can be reconstructed by projection of the two dimensional image through the perspective center of the camera lens. The photographic details which enabled a good depth of field to be obtained are given and the data analysis is described. The estimation of uncertainties is also considered. ESA

**N91-32249#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Wolkenphysik.
**METHODS FOR THE AUTOMATIC DE-ALIASING OF THE DOPPLER VELOCITY OF A WEATHER RADAR**
Martin Hagen and Sabine Stockinger Feb. 1991 65 p In GERMAN; ENGLISH summary
(DLR-FB-91-08; ISSN-0939-2963; ETN-91-90040) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 23 DM

Folding or aliasing of the Doppler velocity is a considerable problem in the analysis and interpretation of weather radar data. Three methods are presented which can be used for post processing of the Doppler velocity. The methods are: a de-aliasing along a single ray of Doppler data; fitting the Doppler velocity to a first guess wind field; and segmentation of the Doppler velocity into areas of similar velocities followed by de-aliasing of adjacent areas. All three methods are combined to support each other. The resulting FORTRAN program DEALIA is described. Several examples show the operation of the program. ESA

**N91-32250*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE TELECOMMUNICATIONS AND DATA ACQUISITION REPORT Progress Report, Apr. - Jun. 1991**
Edward C. Posner, ed. 15 Aug. 1991 419 p
(NASA-CR-188813; JPL-TDA-PR-42-106; NAS 1.26:188813)
Avail: NTIS HC/MF A18 CSCL 17B

This quarterly publication provides archival reports on developments in programs managed by the Jet Propulsion Laboratory's (JPL's) Office of Telecommunications and Data Acquisition (TDA). In space communications, radio navigation, radio science, and ground-based radio and radar astronomy, it reports on the activities of the Deep Space Network (DSN) in planning, in supporting research and technology, in implementation, and in operations. Also included is standards activity at JPL for space data, information systems, and reimbursable DSN work performed for other space agencies through NASA. For individual titles, see N91-32251 through N91-32279.

**N91-32251*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**PRECISE ORBIT DETERMINATION OF HIGH-EARTH ELLIPTICAL ORBITERS USING DIFFERENCED DOPPLER AND RANGE MEASUREMENTS** **c13**
J. A. Estefan *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 1-22 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 22A

Recent advances in Deep Space Network station calibration methods have led to renewed interest in the use of differenced Doppler and range data types for interplanetary navigation. Described here is an orbit determination error analysis of the performance of these differenced data types when used with conventional two-way Doppler for precise navigation of High-Earth Orbiters. Three highly elliptical Earth orbits are investigated, with apogee heights on the order of 20,000 km, 70,000 km, and 156,000 km. Results indicate that the most significant navigational accuracy improvements, relative to the performance obtained from two way Doppler alone, are achieved for the lowest altitude orbit by using differenced Doppler measurements with two way Doppler (assuming that spacecraft onboard downlink antennas have no ground footprint limitation in the near-apogee regime). In the case of the two higher altitude orbits, accuracy improvements over Doppler-only performance, although less dramatic, are also achieved when differenced range measurements are combined with two-way Doppler. Author

**N91-32252*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**ALGORITHMS FOR STRUCTURAL NATURAL-FREQUENCY DESIGN**
R. Levy *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 23-29 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

The algorithms used in the Jet Propulsion Laboratory (JPL) Iterative Design of Antenna Structures (IDEAS) program are furnished. The algorithms are based upon the operational research method of optimality criteria and the structural analysis method of virtual work. Examples of the natural frequency constrained design of an antenna tripod structure are included. Author

**N91-32253*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**PATTERN-RECOGNITION TECHNIQUES APPLIED TO PERFORMANCE MONITORING OF THE DSS 13 34-METER ANTENNA CONTROL ASSEMBLY**
J. A. Mellstrom and P. Smyth *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 30-51 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

The results of applying pattern recognition techniques to diagnose fault conditions in the pointing system of one of the Deep Space network's large antennas, the DSS 13 34-meter structure, are discussed. A previous article described an experiment whereby a neural network technique was used to identify fault classes by using data obtained from a simulation model of the Deep Space Network (DSN) 70-meter antenna system. Described here is the extension of these classification techniques to the analysis of real data from the field. The general architecture and philosophy of an autonomous monitoring paradigm is described and classification results are discussed and analyzed in this context. Key features of this approach include a probabilistic time-varying context model, the effective integration of signal processing and system identification techniques with pattern recognition algorithms, and the ability to calibrate the system given limited amounts of training data. Reported here are recognition accuracies in the 97 to 98 percent range for the particular fault classes included in the experiments. Author

**N91-32254*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**A COOLED 1- TO 2-GHz BALANCED HEMT AMPLIFIER**
Gerardo G. Ortiz and Steven Padin (Owens Valley Radio Observatory, Pasadena, CA.) *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 52-59 Sponsored in part by the Caltech President's Fund (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

The design details and measurement results for a cooled L-band (1 to 2 GHz) balanced high electron mobility transistor (HEMT) amplifier are presented. The amplifier uses commercially available packaged HEMT devices (Fujitsu FHR02FH). At a physical temperature of 12 K, the amplifier achieves noise temperatures between 3 and 6 K over the 1 to 2 GHz band. The associated gain is approximately 20 dB. Author

**N91-32255*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**PERFORMANCE OF A HIGH T(SUB c) SUPERCONDUCTING ULTRA-LOW LOSS MICROWAVE STRIPLINE FILTER c33**
J. J. Bautista, Gerardo G. Ortiz, C. Zahopoulos, S. Sridhar, and M. Lanagan (Argonne National Lab., IL.) *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 60-65 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

Discussed here is the successful fabrication of a five-pole interdigital stripline filter made of the 93-K superconductor (Y1Ba2Cu3O(y)) coated on a silver substrate, with center frequency of 8.5 GHz and an extremely high rejection ratio of 80 dB. The lowest insertion loss measured was 0.1 dB at 12 K, with a return loss of better than 16 dB, representing a significant improvement over a similar copper filter; it is comparable to low critical temperature filters. The insertion loss appears to be limited by extrinsic factors, such as tuning mismatch and joint losses, and not by the superconducting material losses. Author

**N91-32256*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**EQUIVALENT CIRCUIT MODEL OF TRAVELING-WAVE MASER SLOW-WAVE STRUCTURES c33**
J. Shell *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 66-92 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

An approach is presented for deriving transmission line equivalent circuits that can approximately model the S-parameter response of traveling wave maser slow wave structures. The technique is illustrated by computing the S-parameter responses of an X-band and S-band maser slow wave structure and comparing these with experimental measurements. Author

**N91-32257*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SPECTRAL FILTERS FOR LASER COMMUNICATIONS**
K. Shaik *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 93-101 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

Optical communication systems must perform reliably under strong background light interference. Since the transmitting lasers operate within a narrow spectral band, high signal to noise ratios can be achieved when narrowband spectral optical filters can be used to reject out of band light. Here, a set of general requirements for such filters are developed, and an overview is given of suitable spectral filter technologies for optical communication systems. Author

**N91-32258*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**DESIGN AND TESTING OF AN ACTIVE QUENCHING CIRCUIT FOR AN AVALANCHE PHOTODIODE PHOTON DETECTOR c33**
D. Arbel and J. A. Schwartz *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 102-110 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

The photon-detection capabilities of avalanche photodiodes (APDs) operating above their theoretical breakdown voltages are described, with particular attention given to the needs and methods of quenching an avalanche once breakdown has occurred. A brief background on the motives of and previous work with this mode of operation is presented. Finally, a description of the design and testing of an active quenching circuit is given. Although the active quenching circuit did not perform as expected, knowledge was gained as to the signal amplitudes necessary for quenching and the need for a better model for the above-breakdown circuit characteristics of the Geiger-mode APD. Author

**N91-32259*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**ANALYSIS OF A MULTIPLE RECEPTION MODEL FOR PROCESSING IMAGES FROM THE SOLID-STATE IMAGING CAMERA c35**
T.-Y. Yan *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 111-118 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 14B

A detection model to identify the presence of Galileo optical communications from an Earth-based Transmitter (GOPEX) signal by processing multiple signal receptions extracted from the camera images is described. The model decomposes a multi-signal reception camera image into a set of images so that the location

of the pixel being illuminated is known a priori and the laser can illuminate only one pixel at each reception instance. Numerical results show that if effects on the pointing error due to atmospheric refraction can be controlled to between 20 to 30 microrad, the beam divergence of the GOPEX laser should be adjusted to be between 30 to 40 microrad when the spacecraft is 30 million km away from Earth. Furthermore, increasing beyond 5 the number of receptions for processing will not produce a significant detection probability advantage. Author

**N91-32260*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE ADVANCED RECEIVER II TELEMETRY TEST RESULTS AT GOLDSTONE** **c17**
R. Sadr, R. Bevan, and S. Hinedi *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 119-131 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09F

The telemetry performance of the Advanced Receiver II (ARX-II) in tracking and demodulating signals from various deep space missions is described. The tests were performed at Goldstone, and the spacecrafts tracked were Pioneer 10, Pioneer 11, Voyager 2, Magellan, and the International Cometary Explorer (ICE). These missions present a broad range of operating conditions to test the ARX-II in terms of signal-to-noise ratio (SNR) and the symbol rate of the received signal. Author

**N91-32261*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SYMBOL LOCK DETECTION IN THE ARX 2 AND BLOCK 5 RECEIVERS** **c33**
M. Shihabi, S. Hinedi, and B. Shah *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 132-154 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

The performances of 5 symbol-lock detectors are compared. These detectors are the square-law detector with overlapping (SQOD) and nonoverlapping integrators, the absolute-value detectors with overlapping and nonoverlapping integrators, and the signal-power estimator detector (SPED). The analysis considers various scenarios in which the observation interval is much larger than or equal to the symbol-synchronizer loop bandwidth, and which were not considered in previous analyses. Also, the case of threshold setting in the absence of signal is considered. It is shown, that the SQOD outperforms all others when the threshold is set in the presence of a signal, independent of the relationship between loop bandwidth and observation period. On the other hand, the SPED outperforms all others when the threshold is set in the presence of noise only. Author

**N91-32262*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**DESIGN AND STATUS OF THE RF-DIGITIZER INTEGRATED CIRCUIT** **c33**
B. Rayhrer, B. Lam, L. E. Young, J. M. Srinivasan, and J. B. Thomas *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 155-159 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

An integrated circuit currently under development samples a bandpass-limited signal at a radio frequency in quadrature and then performs a simple sum-and-dump operation in order to filter and lower the rate of the samples. Downconversion to baseband is carried out by the sampling step itself through the aliasing effect of an appropriately selected subharmonic sampling frequency. Two complete RF digitizer circuits with these functions will be implemented with analog and digital elements on one GaAs substrate. An input signal, with a carrier frequency as high as 8 GHz, can be sampled at a rate as high as 600 Msamples/sec for each quadrature component. The initial version of the chip will sign-sample (1-bit) the input RF signal. The chip will contain a synthesizer to generate a sample frequency that is a selectable integer multiple of an input reference frequency. In addition to the usual advantages of compactness and reliability associated with integrated circuits, the single chip will replace several steps required by standard analog downconversion. Furthermore, when a very high initial sample rate is selected, the presampling analog filters can be given very large bandwidths, thereby greatly reducing phase and delay instabilities typically introduced by such filters, as well as phase and delay variation due to Doppler changes. Author

**N91-32263*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**CHANNEL ASSIGNMENTS AND ARRAY GAIN BOUNDS FOR THE Ka-BAND ARRAY FEED COMPENSATION SYSTEM**
V. A. Vilnrotter *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 160-169 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

The performance of a real-time digital combining system for use with array feeds was considered previously. The purpose of the combining operation is to recover signal to noise ratio (SNR) losses due to antenna deformations and atmospheric effects. Previously, arbitrary signal powers and noise variances were assumed, but no attempt was made to match the receiver channels to the available signal powers. It is shown that for any signal power and noise variance distribution, a best channel assignment exists that maximizes the combined SNR in the limit of vanishingly small combining losses. This limit can be approached in practice by observing sufficiently many samples. Specific signal power and noise variance distributions are considered, and it is shown that even relatively noisy channels can be used effectively to recover SNR losses resulting from signals diverted out of a high-quality channel by antenna deformations. Author

**N91-32264*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**CODING GAINS AND ERROR RATES FROM THE BIG VITERBI DECODER**
I. M. Onyszchuk *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 170-174 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

A prototype hardware Big Viterbi Decoder (BVD) was completed for an experiment with the Galileo Spacecraft. Searches for new convolutional codes, studies of Viterbi decoder hardware designs and architectures, mathematical formulations, and decompositions of the deBruijn graph into identical and hierarchical subgraphs, and very large scale integration (VLSI) chip design are just a few examples of tasks completed for this project. The BVD bit error rates (BER), measured from hardware and software simulations, are plotted as a function of bit signal to noise ratio E sub b/N sub 0 on the additive white Gaussian noise channel. Using the constraint length 15, rate 1/4, experimental convolutional code for the Galileo mission, the BVD gains 1.5 dB over the NASA standard (7,1/2) Maximum Likelihood Convolution Decoder (MCD) at a BER of 0.005. At this BER, the same gain results when the (255,233) NASA standard Reed-Solomon decoder is used, which yields a word error rate of 2.1 x 10(exp -8) and a BER of 1.4 x 10(exp -9). The (15, 1/6) code to be used by the Cometary Rendezvous Asteroid Flyby (CRAF)/Cassini Missions yields 1.7 dB of coding gain. These gains are measured with respect to symbols input to the BVD and increase with decreasing BER. Also, 8-bit input symbol quantization makes the BVD resistant to demodulated signal-level variations which may cause higher bandwidth than the NASA (7,1/2) code, these gains are offset by about 0.1 dB of expected additional receiver losses. Coding gains of several decibels are possible by compressing all spacecraft data. Author

**N91-32265*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**TESTING INTERCONNECTED VLSI CIRCUITS IN THE BIG VITERBI DECODER** **c33**
I. M. Onyszchuk *In its* The Telecommunications and Data

Acquisition Report 15 Aug. 1991 p 175-182 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09C

The Big Viterbi Decoder (BVD) is a powerful error-correcting hardware device for the Deep Space Network (DSN), in support of the Galileo and Comet Rendezvous Asteroid Flyby (CRAF)/Cassini Missions. Recently, a prototype was completed and run successfully at 400,000 or more decoded bits per second. This prototype is a complex digital system whose core arithmetic unit consists of 256 identical very large scale integration (VLSI) gate-array chips, 16 on each of 16 identical boards which are connected through a 28-layer, printed-circuit backplane using 4416 wires. Special techniques were developed for debugging, testing, and locating faults inside individual chips, on boards, and within the entire decoder. The methods are based upon hierarchical structure in the decoder, and require that chips or boards be wired themselves as Viterbi decoders. The basic procedure consists of sending a small set of known, very noisy channel symbols through a decoder, and matching observables against values computed by a software simulation. Also, tests were devised for finding open and short-circuited wires which connect VLSI chips on the boards and through the backplane. Author

**N91-32266*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**FRAME ERROR RATE OF THE NASA CONCATENATED CODING SYSTEM**
L. Swanson and K.-M. Cheung *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 183-187 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

For a concatenated coding system, the effect of interleaving depth on interleaved frame-error rate is compiled by simulation. Comparisons are made for three different inner convolutional codes; all three systems have a (255,223) 8-bit Reed-Solomon code as an outer code. For all the inner convolutional codes tested, an interleaving depth smaller that 4 causes substantial loss. Author

**N91-32267*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**INITIAL POINTING CALIBRATIONS FOR THE DSS 13 34-METER BEAM-WAVEGUIDE ANTENNA**
L. S. Alvarez *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 188-204 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

The beam pointing of the Deep Space Station (DSS) 13 beam-waveguide antenna at the Goldstone Venus site was calibrated during the postconstruction performance testing period from Jul. 1990 through Jan. 1991. The pointing calibrations were based on errors measured on radio sources at both the Cassegrain and centerline beam-waveguide focal points. The blind pointing performance goal of 5.0 mdeg, 3-sigma at Ka-band (32 GHz) was demonstrated to be met for low (less than 10 mph) wind conditions. Author

**N91-32268*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**MODELING AND SIMULATIONS OF THE DSS 13 ANTENNA CONTROL SYSTEM**
W. Gawronski and J. A. Mellstrom *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 205-248 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

A model of the antenna control system for the azimuth and elevation axes of the Deep Space Station (DSS) 13 antenna is developed. This model is used for simulation of elevation and azimuth dynamics, cross-coupled dynamics, and radio-frequency pointing error due to both input commands and wind disturbances. This model also serves as a tool for the antenna controller design. A modal state-space model of the antenna structure was obtained from its finite-element model with a free-rotating tipping structure and alidade. Model reduction techniques applied separately for the antenna structure, elevation, and azimuth drives, and rate-loop model reduce the system order to one-third of that of the original, while preserving its significant dynamic properties. Extensive simulation results illustrate properties of the model. Author

**N91-32269*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**A PORTABLE Ka-BAND FRONT-END TEST PACKAGE FOR BEAM-WAVEGUIDE ANTENNA PERFORMANCE EVALUATION. PART 1: DESIGN AND GROUND TESTS**
T. Y. Otoshi, S. R. Stewart, and M. M. Franco *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 249-265 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

A unique experimental method was used to test the beam waveguide (BWG) antenna at Deep Space Station (DDS) 13 in the Goldstone Deep Space Communications Complex near Barstow, California. The methodology involved the use of portable test packages to make measurements of operating noise temperatures and antenna efficiencies (as functions of antenna pointing angles) at the Cassegrain focal point and the final focal point located in a subterranean pedestal room. Degradations caused by the BWG mirror systems were determined by making comparisons of the measured parameters at the two focal points of the antenna. Previous articles were concerned with the design, performance characteristics, and test results obtained with an X-band test package operating at 32 GHz. Noise temperature measurement results are presented for the Ka-band test package in an on-the-ground test configuration. Author

**N91-32270*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**A PORTABLE Ka-BAND FRONT-END TEST PACKAGE FOR BEAM-WAVEGUIDE ANTENNA PERFORMANCE EVALUATION. PART 2: TESTS ON THE ANTENNA**
T. Y. Otoshi, S. R. Stewart, and M. M. Franco *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 266-282 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

In part one of this article, a description was given of a Ka-band test package developed to enable testing of the Deep Space Station (DDS) 13 34-m beam-waveguide (BWG) antenna at 32 GHz. Test results were given for the Ka-band test package in an on-the-ground test configuration. This article is a companion article concerned with Ka-band test results for the test package in an on-the-antenna test configuration. Included are Ka-band zenith noise-temperature values, tipping-curve data, and subreflector test results obtained at the Cassegrain focal point, as well as at the final BWG focal point (located in a subterranean pedestal room). Test results show that, through the use of the Ka-band test package, the BWG antenna performance was successfully evaluated at Ka-band. The Ka-band test package operated well in all of the different antenna test configurations. Author

**N91-32271*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**EFFICIENCY CALIBRATION OF THE DSS 13 34-METER DIAMETER BEAM WAVEGUIDE ANTENNA AT 8.45 AND 32 GHz**
S. D. Slobin, T. Y. Otoshi, M. J. Britcliffe, L. S. Alvarez, S. R. Stewart, and M. M. Franco *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 283-297 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

Efficiency measurements at 8.45 and 32 GHz (X and Ka bands, respectively) were carried out on the new 34 m diameter beam waveguide antenna now in use at the NASA Goldstone Deep Space Communications Complex. The use of portable test packages enabled measurements at both the Cassegrain and beam waveguide focal points. Radio sources (quasars and Venus) were used as calibrators, and updated determinations of flux and source size correction were made during the period of the measurements. Gain and efficiency determinations as a function of elevation angle

are presented, and the effects of the beam waveguide system and antenna structure are clearly seen. At the beam waveguide focus, an 8.45 GHz peak efficiency of 72.38 pct. was measured; at 32 GHz, 44.89 pct. was measured. Author

**N91-32272*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**DSS 13 PHASE 2 PEDESTAL ROOM MICROWAVE LAYOUT**
**c33**
T. Cwik and J. C. Chen *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 298-306 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

The design and predicted performance is described of the microwave layout for three band operation of the beam waveguide antenna Deep Space Station 13. Three pedestal room microwave candidate layout designs were produced for simultaneous X/S and X/Ka band operation. One of the three designs was chosen based on given constraints, and for this design the microwave performance was estimated. Author

**N91-32273*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**A CARRIER-ARRAYING DEMONSTRATION AT GOLDSTONE FOR RECEIVING PIONEER 11 SIGNALS**
T. T. Pham, M. K. Simon, T. K. Peng, M. H. Brockman, S. S. Kent, and R. Weller (CDI Consultants, Pasadena, CA.) *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 307-334 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

A carrier arraying technique was demonstrated at Goldstone. The Block III receivers of two 34-m antennas, Deep Space Station 12 and 15, were arrayed together to receive S band (2.3 GHz) signals from the Pioneer 11 spacecraft. Carrier phases in the two receivers were synchronized by the analog phase lock loops, and carrier signals were added at an intermediate frequency to enhance tracking performance. The receiver at DSS 15, which has been unable to lock up and track the Pioneer 11 signal by itself due to a wider tracking loop bandwidth and a higher system temperature, was now able to track the carrier and produce usable baseband signals. The receiver at DSS 12 achieved a reduction of the rms phase error, increasing the telemetry symbol SNR by an average of 0.35 dB. The baseband signals from both antennas were then synchronized and combined using the existing Baseband Assembly, thereby achieving a total symbol SNR increase of 2.5 + or - 0.7 dB relative to DSS 12 alone. A more comprehensive model is presented to permit evaluation of both thermal and phase noise effects. The analysis agrees well with observed data. Author

**N91-32274*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**DELTA VLBI DATA PERFORMANCE IN THE GALILEO SPACECRAFT EARTH FLYBY OF DECEMBER 1990**
D. L. Gray *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 335-352 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

The performance of the delta very long baseline interferometry (Delta VLBI) data type during the recent Earth flyby of the Galileo spacecraft is presented. First, the data are given significance by showing why the mission design requires an accurate flyby. Then, the data's performance is analyzed, including its operational features, as well as its accuracy. Finally, the effectiveness of these data in improving the accuracy of flyby is shown. Comparisons are made between the expected and actual performances of the data. The processing time, reliability, and accuracy of these data were very good, and a solid gain was made in the encounter accuracy. Author

**N91-32275*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**CARRIER-TO-NOISE POWER ESTIMATION FOR THE BLOCK 5 RECEIVER**
A. M. Monk *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 353-363 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

Two possible algorithms for the carrier to noise power (P sub c/N sub 0) estimation in the Block V Receiver are analyzed and their performances compared. The expected value and the variance of each estimator algorithm are derived. The two algorithms examined are known as the I arm estimator, which relies on samples from only the in-phase arm of the digital phase lock loop, and the IQ arm estimator, which uses both in-phase and quadrature-phase arm signals. The IQ arm algorithm is currently implemented in the Advanced Receiver II (ARX II). Both estimators are biased. The performance degradation due to phase jitter in the carrier tracking loop is taken into account. Curves of the expected value and the signal to noise ratio of the P sub c/N sub 0 estimators vs. actual P sub c/N sub 0 are shown. From this, it is clear that the I arm estimator performs better than the IQ arm estimator when the data to noise power ratio (P sub d/N sub 0) is high, i.e., at high P sub c/N sub 0 values and a significant modulation index. When P sub d/N sub 0 is low, the two estimators have essentially the same performance. Author

**N91-32276*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**JPL 1990-3: A 5-nrad EXTRAGALACTIC SOURCE CATALOG BASED ON COMBINED RADIO INTERFEROMETRIC OBSERVATIONS**
O. J. Sovers *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 364-383 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

A combined analysis merges 17,000 Deep Space Network (DSN) Very Long Baseline Interferometric (VLBI) observations with 303,000 observations from the Crustal Dynamics Project (CDP) and the International Radio Interferometric Surveying (IRIS) project. Observations from the Radio Reference Frame Development (RRFD) and Time and Earth Motion Precision Observations (TEMPO) programs through late 1990 form the DSN VLBI data set. The combined analysis yields angular coordinates of extragalactic radio sources with a precision of a few nanoradians, as compared with 5 to 10 nrad precision for coordinates derived in the past solely from DSN data. The improvement in the combined analysis is due to the new Mark III DSN data, as well as to increased statistical strength from the large volume of observations from non-DSN experiments. Such a unified analysis is made possible by recent improvements in parameter estimation software efficiency. The terrestrial reference frame is based on joint VLBI experiments using both DSN and CDP antennas, and on specifying the coordinates of VLBI antennas in a proper geocentric coordinate system by means of Global Positioning System (GPS) collocation of VLBI, LLR, and SLR (Laser Ranging) sites. Author

**N91-32277*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**WIDEBAND WAVEGUIDE POLARIZER DEVELOPMENT FOR SETI**
P. Lee and P. Stanton *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 384-393 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

A wideband polarizer for the Deep Space Network (DSN) 34 meter beam waveguide antenna is needed for the Search for Extraterrestrial Intelligence (SETI) project. The results of a computer analysis of a wideband polarizer are presented. Author

**N91-32278*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**STOCHASTIC AVAILABILITY ANALYSIS OF OPERATIONAL DATA SYSTEMS IN THE DEEP SPACE NETWORK**
T. N. Issa (Bendix Field Engineering Corp., Pasadena, CA.) *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 394-403 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 17B

Existing availability models of standby redundant systems consider only an operator's performance and its interaction with the hardware performance. In the case of operational data systems in the Deep Space Network (DSN), in addition to an operator system interface, a controller reconfigures the system and links a standby unit into the network data path upon failure of the operating unit. A stochastic (Markovian) process technique is used to model and analyze the availability performance and occurrence of degradation due to partial failures are quantitatively incorporated into the model. Exact expressions of the steady state availability and proportion degraded performance measures are derived for the systems under study. The interaction among the hardware, operator, and controller performance parameters and that interaction's effect on data availability are evaluated and illustrated for an operational data processing system. Author

**N91-32279*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**MODELING PREPARATION COSTS FOR SPACE MISSIONS BY USING MAJOR COST DRIVERS c83**
J. S. Sherif, D. S. Remer (Harvey Mudd Coll., Claremont, CA.), and H. R. Buchanan *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 404-415 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 05C

A model is suggested for making long range planning cost estimates for Deep Space Network (DSN) support of future space missions. The model is a function of major mission cost drivers, such as maintenance and operations, downlink frequency upgrade, uplink frequency upgrade, telemetry upgrade, antenna gain/noise temperature, radiometric accuracy upgrade, radio science upgrade, and very long baseline interferometry. The model is derived from actual cost data from three space missions: Voyager (Uranus), Voyager (Neptune), and Magellan. The model allows one to estimate the total cost and the cost over time of a similar future space mission. The model was back tested against the three projects and gave cost estimates that range from 17 pct. below to 19 pct. above actual mission preparation costs. The model was also compared with two other independent projects: Mariner Jupiter/Saturn (MJS later became Voyager) and Viking. The model gave total preparation cost estimates that range from 15 pct. above to 4 pct. below actual total preparation costs for MJS and Viking, respectively. Author

**N91-32280*#** Massachusetts Inst. of Tech., Cambridge.
**OBSERVATIONS OF ENHANCED RADAR BACKSCATTER (ERB) FROM MILLSTONE HILL Semiannual Report**
M. C. Lee 1991 62 p
(Grant NAG5-1055)
(NASA-CR-188877; NAS 1.26:188877) Avail: NTIS HC/MF A04 CSCL 17I

Intense enhancements of the incoherent radar backscatter spectrum from the topside ionosphere were observed with the Millstone Hill UHF radar. Enhancements occurring at the local ion acoustic frequency causing large asymmetries in the measured ion line may be produced by current driven instabilities. These enhancements pose a practical problem for space surveillance systems because their cross section and spectral width are characteristic of satellites. Conversely, their hard target signature complicates the study of naturally occurring ERB events; it is nearly impossible to distinguish them from satellites based on a single measurement. Statistical comparisons of observed coherent echo distributions with predictions from a satellite catalog were used to broadly identify periods of ERB activity. A series of experiments using multiple diagnostics, including satellite instruments, for simultaneous observations have established the association of ERB with large fluxes of soft suprathermal electrons carrying field aligned currents. Zenith data are also presented which show the asymmetric growth of ion acoustic waves directly above Millstone Hill. Details of these results are presented. Author

**N91-32281#** National Telecommunications and Information Administration, Boulder, CO. Inst. for Telecommunication Sciences.
**WIDEBAND HF NOISE/INTERFERENCE MODELING, PART 1. FIRST-ORDER STATISTICS. TECHNICAL MEMORANDUM SERIES**
J. J. Lemmon and C. J. Behm May 1991 120 p Sponsored by Army
(PB91-208454; NTIA-91-277) Avail: NTIS HC/MF A06 CSCL 20N

The development of a wideband HF noise/interface model is discussed. The model is based on measured data and is suitable for implementation in a wideband HF channel simulator. The measured data are described and analyses performed on the data are discussed. Then the proposed noise/interference model is presented. Example results from the model are compared with measured data, and aspects of the model development which require further investigation are discussed. GRA

**N91-32282#** Federal Aviation Administration, Atlantic City, NJ.
**SATELLITE DATA LINK VALIDATION TEST PLAN Technical Report, Dec. 1989 - Oct. 1990**
Hilda M. DiMeo Sep. 1991 19 p
(NASA Order T-0704F)
(DOT/FAA/CT-TN91/6) Avail: NTIS HC/MF A03

The validation process of a satellite data link is described. Aircraft equipped with satellite communication avionics will relay progress reports through a satellite to a ground earth station (GES). These will be compared directly to voice reports made using high-frequency (HF) radio. The results of the comparisons between the different links will be used to determine the suitability of satellite communication as a replacement for HF for oceanic air traffic control. Author

**N91-32283#** Federal Aviation Administration, Atlantic City, NJ.
**DATA MULTIPLEXING NETWORK (DMN), PHASE 3: EQUIPMENT OPERATIONAL TEST AND EVALUATION (OT&E)/INTEGRATION TEST PLAN**
Wayne Bell Oct. 1991 64 p
(DOT/FAA/CT-TN91/24) Avail: NTIS HC/MF A04

The presented plan addresses the Operational Test and Evaluation (OT&E)/Integration testing of the Data Multiplexing Network (DMN) equipment in the current NAS environment. The approach and concept is to conduct integration tests with appropriate National Airspace System (NAS) systems to verify that NAS requirements and DMN specifications and Statistical Multiplexer requirements were satisfied. This will be accomplished by conducting unit level tests at the Federal Aviation Administration (FAA) Technical Center and extensive integration tests at the key test sites of Albuquerque, New Mexico; Denver, Colorado; and Minneapolis, Minnesota Air Route Traffic Control Centers (ARTCC). The DMN equipment being procured includes Deterministic Time Division Multiplexing (DTDM) Commercial Off-The-Shelf (COTS) equipment and the NON-COTS equipment (a/b switch and clock box). This plan describes the test program for the DTDM COTS equipment. Author

**N91-32284#** Wichita State Univ., KS. Inst. for Aviation Research.
**ELECTROMAGNETIC EMISSIONS FROM AN ELECTRO-IMPULSE DEICING SYSTEM IN A COMPOSITE WING EQUIPPED WITH LIGHTNING PROTECTION**
G. W. Zumwalt Sep. 1991 27 p
(Contract DTEA03-89-P-01022)
(DOT/FAA/CT-TN90/32) Avail: NTIS HC/MF A03

Electromagnetic interference (EMI) accompanying the use of

the Electro-Impulse Deicing (EIDI) system was investigated in 1988 and 1989. Results indicated that EIDI emissions inside aluminum wings were almost totally shielded, but EIDI inside composite wings produced emissions exceeding permissible levels unless shielding and grounding was provided for all components. However, lightning protection for composite wings require a fine mesh copper screen grid to be embedded in the composite. The questions arose concerning the shielding effect of this screen, to see if it would significantly reduce EMI from EIDI. Emissions tests were conducted on two similar composite wing leading edges with EIDI installed; one had a lightning protection grid. The results were negative; the embedded lightning protection wire added negligible shielding at all frequencies to the composite leading edge. Author

**N91-32285#** Oak Ridge National Lab., TN.
**EVIDENCE FOR SF4 AND SF2 FORMATION IN SF6 CORONA DISCHARGES**
I. Sauers 1991 10 p Presented at the Electrical Insulation and Dielectric Phenomena Conference, Knoxville, TN, 20-24 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE91-015927; CONF-911087-2) Avail: NTIS HC/MF A02

Direct detection of positive ions produced in positive point-to-plane SF6 corona discharges indicate the formation of SF(x)(+), x = 1 to 5. Estimates of SF3(+), SF2(+) and SF(+) from electron impact dissociative ionization cross section data of SF6 indicate that the experimental values are higher by factors of 10, 59, and 46 respectively. This can be explained on the basis of steady state concentrations of SF4, and the ions SF2(+) and SF(+) are derived from SF2. Further, more direct evidence is given by the observation of cluster ions SF(x)(+)(SF4) and SF(x)(+)(SF2), x = 2,3. The formation of SF4 and SF2 will be discussed in the context of chemical kinetics models and plasma studies which also indicate formation of these species in SF6 discharges and its relevance to stable by-product formation. DOE

**N91-32286#** Lawrence Livermore National Lab., CA.
**INITIAL TESTING OF A TWO-DIMENSIONAL COMPUTER CODE FOR MICROWAVE-INDUCED SURFACE BREAKDOWN IN AIR**
D. J. Mayhall and J. H. Yee Jun. 1991 7 p Presented at the 8th IEEE Pulsed Power Conference, San Diego, CA, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE91-015763; UCRL-JC-105250; CONF-910640-31) Avail: NTIS HC/MF A02

A two-dimensional, electromagnetic, electron fluid computer code for microwave-induced surface breakdown in air is developed. This code is based on finite difference approximations to Maxwell's curl equations for TM(sub om) modes in cylindrical waveguides and electron conservation equations for continuity, momentum, and energy. An implicit, block-iterative, optionally stiff, variable step integrator solves the global set of equations. A 2.856 GHz, 1 MV/m amplitude, radial electric field pulse in a highly dispersive waveguide impinges on two different model field emission structures with the same emission threshold (0.2 MV/m) and rate (10 exp 11/m exp 3 minus s). One structure is a perfectly conducting flat end plate; the other is a perfectly conducting axial stub of 0.413 cm radius by 1.69 cm length, centered on a flat end plate. Pressures vary from 50 to 800 torr. In both cases, peak electric fields occur where expected, initial electron generation is from field emission, and later generation is from avalanching in air. The location of peak generation is at the field maxima. The amount of late time density varies qualitatively with pressure as theoretically expected. DOE

**N91-32287*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**MILLIMETER WAVELENGTH COMMUNICATIONS APPLICATIONS FOR THE SEI**
Denise S. Ponchak, John E. Zuzek, Rodney L. Spence, and Wayne A. Whyte, Jr. 1991 26 p Presented at the Conference on Advanced Space Exploration Initiative Technologies, Cleveland, OH, 4-6 Sep. 1991; sponsored by AIAA, NASA, and OAI Previously announced in IAA as A91-52458
(NASA-TM-105275; E-6598; NAS 1.15:105275; AIAA-91-3589)
Copyright Avail: NTIS HC/MF A03 CSCL 17B

The potentially complex missions of the Space Exploration Initiative (SEI) require advanced lunar communications, navigation, and information systems to provide voice, data, and image transmissions. The objectives here are to determine which SEI telecommunications applications will benefit from millimeter wave technology, assess the state of the art in millimeter wave technology, and describe the technology development shortfalls with respect to potential mission time frames. The assumptions for the analysis as well as other non-performance related issues are also presented. Author

**N91-32288*#** Hawaii Univ., Manoa. Dept. of Electrical Engineering.
**MULTI-DIMENSIONAL MODULATION CODES FOR FADING CHANNEL**
Shu Lin and Jiantian Wu 10 Oct. 1991 33 p
(Grant NAG5-931)
(NASA-CR-188959; NASA-91-003; NAS 1.26:188959) Avail: NTIS HC/MF A03 CSCL 20N

Some new codes are presented which have good performance on Rician fading channel with small decoding complexities. A new M-way partition chain is proposed for the L x MPSK (L less than or equal to M) signal set which maximizes the intra-set distance of each subset at each partition level. Based on this partition chain, a class of asymptotical optimum codes was found. For M = 4, these codes have both large symbol distances and product distances. Multi-level coding scheme allows to construct a code by hand such that the code meets some desired parameters, e.g., symbol distance, product distance, etc. In design of a multi-level code, all factors were considered which affect the performance and complexity of the code, such as, the decoding scheme, decoding complexity, and performance under the decoding scheme, e.g., if the multi-stage decoding scheme is used, the performance degradation due to the suboptimum decoding is taken into consideration. The performance for most of the presented codes was simulated on Rayleigh fading channel, and the results show that these codes have good performance with small decoding complexities. Author

**N91-32289#** Sandia National Labs., Albuquerque, NM.
**MODE-STIRRED CHAMBER FIELD STATISTICS: CORRELATION WIDTHS**
B. Boverie 1991 7 p Presented at the Reverberating Chamber User's Group Meeting, Boulder, CO, 1-2 Aug. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016190; SAND-91-1504C; CONF-9108121-1) Avail: NTIS HC/MF A02

The electromagnetic field in a mode-stirred chamber is a random process. Samples of this random process are random variables. Different realizations of this random variable can be obtained by changing the paddle-wheel angle, changing the frequency, or changing the location at which the sample is taken. Correlation widths can be defined for each of these three variables. For examples, the spatial correlation width is the distance a point sensor must be moved to realize an uncorrelated value of the field (paddle-wheel angle and frequency held constant). Likewise, the paddle-wheel correlation width is the angle through which the paddle wheel must turn to yield an uncorrelated value (location and frequency held constant). The frequency correlation width is the frequency change required to yield an uncorrelated value (location and paddle-wheel angle held constant). These values were determined experimentally for the sandia mode-stirred chamber by sampling the field at equal increments (for each variable) and calculating an autocorrelation function. The autocorrelation function is a random process (because it is calculated from a random process) and must be averaged to determine it width. The correlation widths were found to be less

than 0.1 degree for paddle-wheel angle, 50 kHz for frequency, and half a wavelength for spatial location. DOE

**N91-32699*#** Dassault (E. M.) Co., Saint Cloud (France).
**ELECTROMAGNETIC TOPOLOGY: CHARACTERIZATION OF INTERNAL ELECTROMAGNETIC COUPLING**
J. P. Parmantier, J. P. Aparicio, and F. Faure (Office National d'Etudes et de Recherches Aerospatiales, Paris, France ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 11 p Previously announced in IAA as A91-45613 (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 20N

**N91-32701*#** Centre d'Etudes de Gramat (France).
**A THEORETICAL ANALYSIS OF THE ELECTROMAGNETIC ENVIRONMENT OF THE AS330 SUPER PUMA HELICOPTER EXTERNAL AND INTERNAL COUPLING**
F. Flourens, T. Morel, D. Gauthier, and D. Serafin *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 12 p Sponsored in part by Direction des Recherches, Etudes et Techniques (DRET) (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 20N

# 33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

**N91-32290** State Univ. of New York, Buffalo.
**ACTIVE DAMPING USING A CONTROL STRUCTURE INTERACTION APPROACH Ph.D. Thesis**
Jeffrey W. Umland 1991 144 p
Avail: Univ. Microfilms Order No. DA9121075

The vibration control of flexible structures using electromagnetic actuators is investigated. A model of an electromagnetic voice coil actuator is developed from elementary theory, and the required parameters are measured. Given a constant magnetic field, the force output of the voice coil varies linearly with the current flowing through the coil. The primary damping mechanism of the actuator used is found to be Coulomb friction. It is seen that Coulomb friction inhibits the response of the actuator to low levels of excitation. It is also seen that the actuator displayed a nonlinear relationship between force and current indicating that the applied magnetic field was not constant. This nonlinearity leads to a closed loop instability. Several design improvements are considered. Four different feedback control laws are developed to add active damping to a structure. The actuator is used as both a point force source and as a link in a mechanism that applies bending moments at two places on the structure. The actuator is used as both a point force source and as a link in a mechanism that applies bending moments at two places on the structure. The first control law uses the actuator as a traditional passive vibration absorber. The second control law is direct structural velocity feedback plus direct proof mass position feedback. The third control strategy is also direct structural velocity feedback but using compensated feedback of the proof mass position. The compensator is designed according to an H infinity optimization technique. The fourth control law uses the actuator as an equivalent mechanical viscous damper connected to two points on the structure. The results show that using direct structural velocity feedback provides improved vibration suppression in comparison to a traditional vibration absorber. Furthermore, the tuning criteria is only restricted to maintaining the actuator's single degree of freedom natural frequency below those of the structure to which it is attached. It is also seen that H infinity control design is not appropriate for vibration suppression since it produces a compensator that relies upon a pole zero cancellation.
Dissert. Abstr.

**N91-32291#** European Space Agency, Paris (France).
**ESA ELECTRONIC COMPONENTS CONFERENCE**
Brigitte Kaldeich, ed. Mar. 1991 600 p In ENGLISH and FRENCH Conference held in Noordwijk, Netherlands, 12-16 Nov. 1990
(ESA-SP-313; ISBN-92-9092-094-7; ETN-91-99560) Copyright
Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

In this first ESA electronic components conference the electronic components needed for the Columbus, Hermes, Ariane 5, Horizon 2000 and other major ESA programs, are discussed. New component technologies, Application Specific Integrated Circuits (ASIC's) and Very Large Scale Integration (VLSI) are reviewed. Microwave and optoelectronics, hybrids and packaging, dosimetry and imaging charge coupled devices are discussed. Single event upset and latchup, and Silicon On Isolator (SOI) technology are considered. Data bases, procurement approaches and policy as well as assessment methodologies and component standardization are reviewed. For individual titles, see N91-32292 through N91-32394.

**N91-32292#** Swiss Center for Electronics and Microtechnology, Inc., Neuchatel.
**DEVELOPMENT OF SEMICONDUCTOR TEST STRUCTURES FOR RELIABILITY EVALUATION**
P. Weiss and L. Adams (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 15-19 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A reliability test circuit including a full set of specific structures is described. Its patterns address the most significant failure mechanisms for Complementary Metal Oxide Semiconductor (CMOS) technology. The overall layout is specially adapted to reliability testing. Among the implemented structures are diodes, gate oxide capacitors, metal lines for electromigration and corrosion measurements. Paired transistors allow device degradation studies. Latchup patterns and surface ion detectors are included. Results related to electromigration, hot carrier effects and surface ion detection are presented. ESA

**N91-32293#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
**GaAs/Ge SOLAR CELL FOR SPACE APPLICATIONS**
Jose Antonio GonzalezdelAmo *In its* ESA Electronic Components Conference Mar. 1991 p 21-24 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

GaAs/Ge solar cells offer important advantages over silicon cells for space applications. The use of Ge rather than fragile, expensive GaAs substrates, provides the option of stronger, larger and thinner cells, with all the electrical advantages of GaAs cells. The properties of the interface between the Ge substrate and the GaAs buffer layer are of fundamental importance in order to obtain better GaAs on Ge devices. The properties of the GaAs/Ge interface are studied. The effect of misorientation in the Metal Organic Chemical Vapor Deposition (MOCVD) growth of GaAs epitaxial layers on Ge (100) substrates, and the growth conditions and the measurement problems that arise in the analysis of the GaAs/Ge interface are addressed. ESA

**N91-32294#** Societe d'Applications Generales d'Electricite et de Mecanique, Cergy-Pontoise (France).
**NON VOLATILE SOLID STATE MAGNETIC MEMORY TECHNOLOGIES** **c60**

Michel A. Poirier *In* ESA, ESA Electronic Components Conference Mar. 1991 p 25-29 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The basic properties of Vertical Block Line (VBL) technology are summarized. VBL memory has a potential density of one gigabit per square centimeter. Also discussed are the space qualified magnetic bubble components produced by SAGEM. The capacity of the components made by SAGEM so far are 8 Mbits and 16 Mbits in density. The upper limit possible using the older technology is 32 Mbits. By using VBL pairs, the density is only limited by the line width of the photolithographic process. ESA

**N91-32295#** Interuniversity Micro-Electronics Center, Leuven (Belgium).
**NEW DEVELOPMENTS IN NON-VOLATILE SEMICONDUCTOR MEMORY TECHNOLOGIES AND DEVICES c60**
H. E. Maes, G. Groeseneken, and J. Witters (MIETEC, Oudenaarde, Belgium ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 31-42 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The state of the art and the new trends in reprogrammable nonvolatile memories are presented. The physical operation principles evolution, in technology, device concepts and new developments and trends for each class of nonvolatile memory are discussed. Erasable Programmable Read Only Memories (EPROM), full feature and flash Electrically Erasable Programmable Read Only Memories (EEPROM), nonvolatible RAM (Random Access Memory) and Ferroelectric RAM (FRAM) are described. Reliability and radiation related problems specific to the above mentioned memory types are discussed. ESA

**N91-32296#** Interuniversity Micro-Electronics Center, Leuven (Belgium).
**OPTIMIZATION OF CMOS TECHNOLOGY AND DESIGN FOR DEEP CRYOGENIC ANALOG CIRCUITS**
B. Dierickx, E. Simoen, J. Vermeiren, S. Cos, C. Claeys, and G. Declerck *In* ESA, ESA Electronic Components Conference Mar. 1991 p 43-47 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Complementary Metallic Oxide Semiconductor (CMOS) technology is used to build analog circuitry for operation at liquid helium temperatures. At this low temperature, the silicon Metal Oxide Semiconductor Field Effect Transistors (MOSFET) features anomalous behavior is known as kink and hysteresis behavior. A few of the technological and design measures that can be used to relieve the above mentioned problems are outlined. An overview is given of the design constraints needed for proper operation of analog CMOS circuits from room temperature applications to deep cryogenic temperatures. ESA

**N91-32297#** Rockwell International Corp., Houston, TX. Rocketdyne Div.
**DESIGN, DEVELOPMENT, AND QUALIFICATION OF SPECIAL SUPER N-CHANNEL MOSFET DIE FOR SPACE APPLICATIONS**
Haskel M. Joseph *In* ESA, ESA Electronic Components Conference Mar. 1991 p 49-53 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The design, manufacture, processing and testing of special super Metal Oxide Semiconductor Field Effect Transistors (MOSFET) die sizers 9 and 10 (approx. 690 by 500 mils and 1022 by 772 mils respectively) are described. These sizes are developed specifically to meet the requirements of the Remote Power Controller (RPC), the Remote Bus Isolator (RBI) and the DC to DC converter of the Space Station Freedom power management and distribution system. The reliability goal is for a 15 year failure free operation in space. ESA

**N91-32298#** Centre National d'Etudes Spatiales, Toulouse (France).
**CNES ACTIVITIES ON ASIC**
R. M. Ecoffet, F. Pressecq, and J.-L. Venturin *In* ESA, ESA Electronic Components Conference Mar. 1991 p 57-62 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Quality assessment methods developed to test Application Specific Integrated Circuits (ASIC) are described. It is found that conventional quality assessment methods based on a standard components approach are not applicable to testing ASIC to be used on space project applications. Special attention is given to technology evaluation and test characterization. Application of the results obtained to the CNES Preferred Parts List (PPL) project is described. Application of the quality assessment methods to other European projects is discussed. ESA

**N91-32299#** ABB Hafo A.B., Jaerfaella (Sweden).
**DESIGN AND MANUFACTURE OF SPACE ASICs TODAY AND TOMORROW: PROMISES AND PROBLEMS**
Ingmar Hoeglund *In* ESA, ESA Electronic Components Conference Mar. 1991 p 63-66 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A few important items limiting Application Specific Integrated Circuits (ASIC) use in space, such as visual inspection and testability, differences in ESA and MIL standards and the large number of hierarchical levels between the end user and the ASIC manufacturer are described. Although ASICs are the flagship of electronics due to their high speed, their functional complexity and reliability, and their low power dissipation, they are in many ways incompatible with the careful conservative approach required for success in space projects. The lack of experience with ASICs in space projects as compared to other more commercial projects is discussed. ESA

**N91-32300#** Alcatel Espace, Toulouse (France).
**DIGITAL ASIC DESIGN FOR SPACE APPLICATIONS**
L. Baguena, S. BenAmor, and G. Gregoris *In* ESA, ESA Electronic Components Conference Mar. 1991 p 67-70 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A digital Application Specific Integrated Circuit (ASIC) design methodology for space applications is presented. Experience in ASIC design used in developing the methodology is described. The flowchart of ASIC development from the system specification level to Hirel part procurement is presented. Specific points such as the choice of technology and manufacture as well as worst case and test oriented simulations are described. The different reviews which are the backbone of the methodology are outlined. Close collaboration between quality and design teams throughout the development cycle is identified as being essential for success. A specific example of the impact of an early reliability analysis on a design architecture is described. The impact of new design tools on ASIC design is outlined. ESA

**N91-32301#** University Coll., Cork (Ireland). National Microelectronics Research Centre.
**ASSESSMENT OF DFT STRATEGIES**
C. T. Hannon, J. F. Page, and S. U. Lidholm *In* ESA, ESA Electronic Components Conference Mar. 1991 p 71-76 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The Design For Testability (DFT) concept is motivated by the increasing difficulty to adequately test Very Large Scale Integration (VLSI) chips whose density has increased rapidly in the past

decade. DFT strategies with respect to different logic architectures are presented. A test vehicle is designed and then utilized to implement these techniques. The results are presented and compared. Fault simulators, in their efforts to establish how well the test vectors used to verify a finished product will catch manufacturing defects, have continuously adopted the stuck at fault model as their only fault modeling criteria. Criticism of using this fault model in Complementary Metal Oxide Semiconductor (CMOS) VLSI design is presented. ESA

**N91-32302#** GEC-Plessey Semiconductors, Lincoln (England).
**AN 8 BIT HIGH PERFORMANCE ADC IN SILICON ON SAPPHIRE**
N. M. Mallinson, M. Lysejko, and A. S. Repton *In* ESA, ESA Electronic Components Conference Mar. 1991 p 77-81 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The suitability of Complementary Metal Oxide Semiconductor (CMOS) Silicon On Sapphire (SOS) process technology for the implementation of monolithic high speed Analog to Digital Converters (ADC's) is investigated and the most appropriate converter architecture identified. A detailed design phase including extensive simulation of key circuit elements using the BSOS transistor model is described. Results indicate that 8 bit flash ADCs with conversion rates in excess of 50 M samples per second can be reliably manufactured. The potential radiation hard attributes of CMOS SOS contribute to an encouraging total dose radiation tolerance of up to 200 krads in initial tests on the MA6561 converter. Further work underway to correct minor problems in first iteration design and to subsequently enhance the radiation tolerance of the conveter is described. ESA

**N91-32303#** Plessey Research (Caswell) Ltd., Towcester (England).
**AN EVALUATION PROGRAMME FOR THE CAPABILITY APPROVAL OF GaAs MMICs**
R. F. B. Conlon, C. E. Lindsay, G. M. Brydon, and A. Bensoussan (Alcatel Espace, Toulouse, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 85-91 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The evaluation phase of the ESA capability approval program (ESA/SCC 24390) for space qualification of the Plessey GaAs foundry is described. The requirements of microwave integrated circuits and in particular the need for bare die are discussed. Preliminary designs for tests vehicles are described and details of the step stress, accelerated temperature and radiation testing are presented. The active involvement of Alcatel Espace, a foundry customer and ESA subcontractor is seen as an important element to ensure that the needs of the system users are fully accounted for in the program. ESA

**N91-32304#** Centre National d'Etudes des Telecommunications, Lannion (France).
**A SURVEY OF THE PARASITIC EFFECTS AND DEGRADATION MECHANISMS AFFECTING THE GaAs FET-BASED IC's: THE FIRST STEP FOR A TECHNOLOGICAL EVALUATION**
J. M. Dumas *In* ESA, ESA Electronic Components Conference Mar. 1991 p 93-99 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Several parasitic effects which influence GaAs IC performance are reviewed. The main concerns include in bulk trap dependent parasitics such as back (side) gating, and surface induced parasitics such as gate-lag. How the basic understanding of these effects is taken into account in the design rules provided to designers is discussed. Major degradation mechanisms are briefly reviewed. Failure modes observed from high temperature lifetesting conditions are demonstrated to give optimistic median life values when compared with those obtained from low temperatures. Failure criteria are reviewed. In order to assess the effects penalizing the integration and lifetime for both analog and digital IC's, a first step qualification procedure is proposed. It is based on specific test vehicles, issued from Process Control Monitors (PCM) or from specially designed Technology Characterization Vehicles (TCV). ESA

**N91-32305#** Philips Components, Caen (France).
**RELIABILITY OF MICROWAVE BIPOLAR SILICON TRANSISTORS**
G. Bobin and J. M. Lemenager *In* ESA, ESA Electronic Components Conference Mar. 1991 p 101-106 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Reliability of solid state technology in power amplifiers for space applications is discussed. Life curves and life goals for such amplifiers are presented. Failure mechanisms are discussed. Different types of screening are presented and discussed. The influence of development and processing of the transistors on one side, and the conditions of use, both electrical and mechanical, on the other side are reviewed. The phenomenon of end of life is presented. Test results from over 20,000 hours of real testing and more than 10 years of experience in the microwave field, for space application are used in this reliability analysis. ESA

**N91-32306#** ANT Nachrichtentechnik, Backnang (Germany, F.R.).
**SELECTION STRATEGY AND RELIABILITY ASSESSMENT FOR SILEX-COMMUNICATION LASER DIODES** **c36**
Roland Loeffler and Bodo Menke *In* ESA, ESA Electronic Components Conference Mar. 1991 p 107-112 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Steps involved in the search for suitable laser diodes for Semiconductor laser Intersatellite Link EXperiment (SILEX) and evaluation of their capabilities in meeting qualification requirements are discussed. A baseline of the laser diode functional specifications is identified by synthesizing the SILEX system requirements and thereby predicting the desired diode characteristics. Samples of approximately 20 different laser diode types are submitted to comprehensive measurements of their characteristics, spectral widths, mode hopping behavior, far field patterns, wave front errors and astigmatisms under modulation. An evaluation program consisting of a conventional three temperature aging test and sensitivity and environmental tests is defined. ESA

**N91-32307#** Centre National d'Etudes des Telecommunications, Lannion (France).
**DIRECT INFLUENCE OF CHIP DESIGN AND MATERIAL COMPOSITION ON GaAs/GaAlAs LASER DIODES RELIABILITY** **c36**
P. Devoldere, M. Robinet, B. Bauduin, and D. Riviere *In* ESA, ESA Electronic Components Conference Mar. 1991 p 113-118 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

GaAs/GaAlAs laser diodes with the same overall structure, but with different aluminum contents in their respective active layer are submitted to accelerated aging tests. The two types of devices have drastically different behaviors during aging. Devices with the higher x sub Al (lambda = 825 nm) age fairly well, while devices with the lower x sub Al (lambda = 875 nm) degrade very fast. The failure mechanisms responsible for fast degradation of 875 nm lasers are investigated by scanning electron microscope experiments with the Electron Beam Induced Current (EBIC) mode. The results obtained show that the degradation primarily occurs close to the mirror facets and then propagates throughout the laser stripe. ESA

**N91-32308#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

**SPACECRAFT POWER SYSTEM CONCERNS REGARDING FAILURE MODES WITHIN COMPLEX INTEGRATED CIRCUITS AND HYBRID PACKAGES** **c20**

J. E. Haines *In its* ESA Electronic Components Conference Mar. 1991 p 121-125 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Failure modes associated with the utilization of complex integrated circuits and electronic hybrid packages within spacecraft power system designs are presented. With the purpose of highlighting these concerns, application of space qualified power controller integrated circuits and hybrid packaging concepts are considered. Basic rules to be considered when using such devices in spacecraft power systems are outlined. ESA

**N91-32309#** MATRA Espace, Paris-Velizy (France). Microelectronics and Packaging Depts.

**SURFACE MOUNT ON CERAMIC: HOW TO ACHIEVE A SPACE QUALITY LEVEL** **c27**

Michel Massenat *In* ESA, ESA Electronic Components Conference Mar. 1991 p 127-132 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Space qualification tests carried out on electrical components produced using surface mount on ceramic technology are described. The steps taken to develop the industrial procedure for this technology are described. The use of ceramic is considered a transient technology in preparation for development of surface mount on printed circuit boards. A process description is presented outlining the composition of the multilayer substrates and the steps involved in component assembly. The manufacturing equipment and qualification stages are described. ESA

**N91-32310#** Limburgs Univ., Diepenbeek (Belgium). Materials Research Inst.

**A NEW APPROACH TO THE RELIABILITY OF ELECTRONIC MATERIAL SYSTEMS**

L. DeSchepper, W. DeCeuninck, B. VanHecke, E. Beyne, L. M. Stals, and J. Roggen (Interuniversity Micro-Electronics Center, Leuven, Belgium ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 133-138 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

An experimental technique developed to study accelerated ageing of material systems used in microelectronics is described. The method is useful for material systems of which the aging can be characterized by the DC electrical resistance or the AC impedance. The main advantage of the in situ approach is the high measuring resolution that can be obtained. The resolution can be in the order of 1 to 5 ppm for a system with a temperature coefficient of resistance of 100 ppm/C whereas the comparable resolution with the conventional method is in the order of 500 ppm. The aging kinetics of a system can be studied in more detail, and on shorter time scales. Some typical applications of the in situ technique are outlined. Hybrid thick film resistor aging, diffusion and electromigration induced aging of gold aluminum contact, and oxidation/deoxidation behavior of superconducting YBaCuO are described. ESA

**N91-32311#** Plessey Research (Caswell) Ltd., Towcester (England).

**HIGH PERFORMANCE PACKAGES FOR SPACE APPLICATIONS** **c20**

K. Beasley and J. T. Lynch *In* ESA, ESA Electronic Components Conference Mar. 1991 p 139-143 (For primary document see N91-32291 24-33)

(Contract ESTEC-8058/88/NL/RE(SC))

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A comprehensive review of packaging for high performance microelectronics is presented. A capability approval approach to package supply is predicted to ensure high performance packages suitable for space applications, and provide the range of special electrical and mechanical characteristics needed to exploit the latest semiconductor technology. Conventional chip and wire assemblies are deemed to be reaching their limits. Flip-chip bonding, which is inherently more reliable, is recommended to avoid wire bonding difficulties for 200 plus pins. Flip-chip bonding into Multi Chip Modules (MCMs), which provides a highly compact alternative to chip carrier to substrate assemblies, is discussed. ESA

**N91-32312#** Alcatel Espace, Toulouse (France).

**QUALIFICATION STRATEGY FOR MULTI-CHIP PACKAGING FOR SPACE APPLICATIONS** **c20**

A. Bensoussan, G. Gregoris, and P. Coval *In* ESA, ESA Electronic Components Conference Mar. 1991 p 145-148 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A qualification strategy for the integration of Monolithic Microwave Integrated Circuits (MMIC) into real systems is described. An overview of the MMIC based predevelopment conducted at Alcatel Espace is presented. The methodology to be used for the implementation of packaged MMICs in these systems and the qualification approach taking into account multiprocurement chips, packages and several assembling subtechnologies are described. The main conclusion is that foundry services, equipment manufacturers and agencies need to work in close conjunction with one another. ESA

**N91-32313#** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsion Systems Div.

**WITHSTANDING VOLTAGE DEGRADATION OF EEE COMPONENTS DUE TO CAVITY PRESSURE LOSS**

Rolf Rieger, Michael Regula, and Ole Pedersen *In* ESA, ESA Electronic Components Conference Mar. 1991 p 149-156 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Hermeticity problems of Electric, Electronic and Electromechanical (EEE) components are discussed. Ways of withstanding voltage degradation of components designed and qualified for operating voltages of greater than or equal to 50 volts are described. The underlying physical background of the problem is discussed. Experimental results are presented illustrating gas discharge phenomena, glow discharge, and arc discharge. Glow discharge of several representative two wire gaps (0.5 through 10 mm) are presented. Experimental set ups and results are shown in diagrammatic form. ESA

**N91-32314#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

**TEST ON OPTO COUPLERS IN THE LINEAR APPLICATION CONSIDERING TEMPERATURE, RADIATION AND Vce EFFECTS** **c74**

H. Spruijt, K. Burrows, J. Andersen, S. Marsden, and J. Tilmant (Etudes Techniques et Constructions Aerospatiales, Charleroi, Belgium ) *In its* ESA Electronic Components Conference Mar. 1991 p 159-164 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The test result for four different types of opto couplers (20 devices each) operating at very low current levels (lower than the test condition for logic operation) considering temperature, radiation and absolute value of forward voltage (Vce) effects are presented.

A galvanically isolated precision linear interface using a pair of opto couplers is introduced, which could be of interest in the areas of monitoring, control, control loops and linear interfaces for future space applications. ESA

**N91-32315#** Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
**SPACE QUALIFICATION TEST AND EVALUATION OF JHU/APL DESIGNED ASICs**
K. Chao *In* ESA, ESA Electronic Components Conference Mar. 1991 p 165-169 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The results of accelerated life tests on spectrum accumulators using MOSIS/HP three micron Complementary Metal Oxide Semiconductor (CMOS) technology are presented. Results of screening and 2000 hours of life tests are used to determine the reliability of the accumulators for spaceborne applications. The MOSIS/HP process is found to yield consistent circuit and transistor parameters equivalent to those obtained using HCMOS technologies. Careful precap and visual inspection and packaging are determined to be essential for this and other high reliability applications. ESA

**N91-32316#** University Coll., Cork (Ireland). National Microelectronics Research Center.
**ASSESSMENT OF p-METALLISATIONS FOR HIGH POWER GaAs LASER DIODES** **c36**
Cormac S. Long and W. M. Kelly *In* ESA, ESA Electronic Components Conference Mar. 1991 p 171-172 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The quality of the p type ohmic contact is critical for GaAs laser diodes due to its higher current density and closer proximity to the active region. The annealing of the contact is strongly related to reliability. Different processes are optimized on test structures and compared with respect to contact resistivity and reliability. These processes are Au/Zn, Au/Cr and a hybrid Au/Zn/Cr process. Au/Zn shows slightly lower contact resistivity while Au/Cr is found to be more reliable after accelerated stressing. The hybrid process is an attempt to combine these two properties of high performance and high reliability. ESA

**N91-32317#** ITT Sealectro (UK), Portsmoutyh (England).
**MICROWAVE BLIND MATE COAXIAL CONNECTORS**
M. White, J. Pierce, and G. Cunningham *In* ESA, ESA Electronic Components Conference Mar. 1991 p 173-174 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A microwave blind mate intermodular connector is described. The connector offers the designer of satellite payloads benefits in weight and volume. This allows for either a smaller system or for more electronics within the original payload limits. Modular flush mounting construction of units is achieved by use of recessed plugs, which are coaxially interconnected using a specially designed slide on jack to jack adaptors. By virtue of this special design, synchronous multiple connections per box can be achieved without special attention to tolerances, while maintaining electrical and mechanical integrity. Weight and volume are reduced through elimination of cable assemblies and increased connector packing density opportunity. ESA

**N91-32318#** Plessey Research (Caswell) Ltd., Towcester (England).
**HIGH PERFORMANCE PACKAGES FOR SPACE APPLICATIONS: REVIEW OF PACKAGING AND ASSEMBLY METHODS FOR LONG WAVELENGTH LASER DIODES** **c36**
C. E. Lindsay *In* ESA, ESA Electronic Components Conference Mar. 1991 p 175-178 Sponsored by ESA (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Laser diode mounting and packaging techniques are discussed and the space compatibility of the materials and designs reviewed. Materials and designs are examined against the drive current, output power, temperature, and environmental and mechanical conditions specific to space applications. Low power laser diodes for optical databases and laser diodes operating at more than 20mW CW optical output power, suitable for free space links are considered. Particular areas of study are thermal effects at the chip/heat sink interface, package rigidity and hermiticity, chip bonding and coupling of the lasers optical output to either a telescope or a fiber. ESA

**N91-32319#** Souriau, Paray (France). Space Div.
**MATING AND UNMATING OF MULTI-PIN CONNECTORS UNDER VACUUM**
Y. Dohan *In* ESA, ESA Electronic Components Conference Mar. 1991 p 179-180 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Future spacecraft designed for a long life in orbit require serviceable modules and reliable electrical connectors which can operate in space vacuum. Numerous applications are described, all relying on the same basic experimentation and development results. Results of tests simulating the life conditions expected for such equipment are presented. A dedicated test jig is used in these tests to accomodate mating and unmating sequences in a vacuum chamber. ESA

**N91-32320#** Tecnologica S.A., La Laguna (Spain).
**SPACE SILICON DIODES: A SURVEY OF AVAILABLE TECHNOLOGIES AND RELATED MANUFACTURING AND RELIABILITY ASPECTS**
A. DiezdeFrutos *In* ESA, ESA Electronic Components Conference Mar. 1991 p 181-186 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The technological, reliability and availability aspects of space silicon diodes are reviewed. Destructive Physical Analysis (DPA) and failure analysis of diodes produced by various manufacturers are presented. The current status of qualification, adherence to applicable specifications and lifecycle of the diodes are outlined. The small number of European space diode manufacturers is described. Only SIEMENS in Germany, TEKELEC in France and M/A-CON in Britain remain as truly European diode manufacturers. Dependency on U.S. sources for low frequency and power diodes is expected to continue until the turn of the century. ESA

**N91-32321#** Selenia Spazio S.p.A., Rome (Italy).
**THE ROLE OF PHOTOSENSITIVE POLYIMIDES IN THE DEVELOPMENT OF HYBRID SPACE HARDWARE** **c27**
U. DiMarcantonio and R. Cirone *In* ESA, ESA Electronic Components Conference Mar. 1991 p 187-192 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Some applications of photosensitive polyimide in hybrid manufacturing are presented. The use of polyimide as a dielectric in thin film multichip modules is described. It has been used to up to 4 conductor layer structures with interconnection vias up to 50 micrometers in thickness. Air bridge manufacturing on lange couplers is also considered. Thin film resistor passivation allowing for good results in Water Drop Tests (WDT) is discussed. ESA

**N91-32322#** Compagnie d'Electronique et de Piezo-Electricite, Argenteuil (France).
**QUALIFICATION STATUS OF HYBRID CRYSTAL OSCILLATORS STYLE OTO 16S FOR SPACE APPLICATION**
E. Gerard and J. L. Deviller *In* ESA, ESA Electronic Components

Conference Mar. 1991 p 193-199 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The qualification status of a crystal clock oscillator, OTO 16S, is described. Specifically designed for the Telecom 2 and Intelsat 7 programs, the oscillator is available in frequencies between 3 and 25 MHz with Transistor Transistor Logic (TTL) compatible outputs. Qualification tests results are presented to demonstrate that all the OTO 16S performances are in compliance with space requirements. From a mechanical viewpoint, no degradation is seen from a vibration level of 50 g sinus 10 to 2000 Hz. From a life test viewpoint, no significant variations are observed after 2000 hours of testing. ESA

**N91-32323#** Texas Instruments France, Velizy-Villacoublay. Regional Technology Center.
**AN ADVANCED TESTABILITY CONCEPT FOR SPACE APPLICATIONS** **c38**
Odile Grimberg *In* ESA, ESA Electronic Components Conference Mar. 1991 p 201-203 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The contribution of Texas Instruments to the efforts of the Joint Tests Action Group in developing a structured test methodology for devices, boards, subsystems and systems, is described. The test methodology, designed to reduce test costs and test time over the lifecycle of the product, is outlined. The role of Texas Instruments in improving the ease and accuracy of fault detection and isolation is reviewed. Various aspects of the International Electric, Electronic and Electromechanical (IEEE) standard initiated by the Joint Tests Action Group are discussed. ESA

**N91-32324#** Philips Components, Caen (France).
**BIPOLAR MICROWAVE TRANSISTOR TECHNOLOGY**
G. David and M. Etienne *In* ESA, ESA Electronic Components Conference Mar. 1991 p 205-207 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The 5 GHz technology used by Philips Composants for bipolar microwave transistors is described. It allows the processing of high performance components. Results of the technological evaluation program are given. They demonstrated the excellent reliability of these kinds of devices. Recent improvements introduced in the process point towards a 5 GHz technology which will allow improvement both in performance and reliability. The improvements and other possible future developments are outlined. ESA

**N91-32325#** Spartan Microwave Ltd., Cosham (England).
**ASSEMBLY AND PACKAGING OF MICROWAVE GALLIUM ARSENIDE DEVICES FOR THE SPACE ENVIRONMENT**
C. Wescott *In* ESA, ESA Electronic Components Conference Mar. 1991 p 209-213 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Work carried out investigating the placement, wire bonding and packaging of gallium arsenide devices for space applications is described. Selection of adhesives for die placement and lid sealing and comparison with a gold/tin eutectic for the same process are described. An investigation of thermosonic gold wire wedge bonding is presented. Identification of a ceramic microwave package is performed. Stress testing intended to be carried out on specially selected test pieces is discussed. ESA

**N91-32326#** Alcatel Espace, Toulouse (France).
**SURFACE MOUNT TECHNOLOGY ON PCBs AT ALCATEL ESPACE**
F. Bouton *In* ESA, ESA Electronic Components Conference Mar. 1991 p 215-219 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Tests performed on Surface Mount Components (SMCs) on polyimide printed circuit boards are described. The SMCs are passive chips and leadless ceramic chip carriers. The boards range from double sided Printed Circuit Boards (PCBs) to complex multilayer PCBs with heat sinks and buried vias. The technology described is used on ERS 1, ERS 2, Telecom 2, Poseidon, Eutelsat 2, Eutelsat 7, SPOT 4 and HELIOS. ESA

**N91-32327*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**TEST CHIPS AND ASIC QUALIFICATION**
M. G. Buehler, B. R. Blaes, Y.-S. Lin, N. Zamani, and U. Lieneweg *In* ESA, ESA Electronic Components Conference Mar. 1991 p 221-226 Sponsored in part by DOD (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders CSCL 09C

A test chip set being developed to aid in the qualification of spaceborne Application Specific Integrated Circuits (ASICs) is described. The chip set consists of a process monitor for process parameter verification, a fault chip for yield analysis, a reliability chip for ASIC failure rate analysis, and total ionizing dose and single event upset chips for radiation effect analysis. The test structures contained in these chips are discussed along with representative test results. ESA

**N91-32328#** University Coll., Cork (Ireland). Microelectronics Technology Support Lab.
**MTSL-005: RELIABILITY EVALUATION OF HIGH PINCOUNT HERMETIC CERAMIC PACKAGES FOR SPACE APPLICATIONS**
J. Barrett, T. Hayes, B. Milner, G. OMalley, C. OMathuna, and T. Yamada *In* ESA, ESA Electronic Components Conference Mar. 1991 p 227-233 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Investigation of the reliability of high pincount (64 to 200 input/output) hermetic ceramic packages, concentrating on leaded surface mount packages and on pin grid arrays is discussed. The work program has a number of objectives, one of which is to determine the fundamental reliability, for space applications, of high pincount ceramic packages from manufacturers in Europe, Japan and the United States. Another objective is to measure the thermal resistances and electrical parameters of these packages and to compare these with theoretically derived values. Evaluating the reliability of different solder assembly techniques for high pincount, fine pitch, surface mount Integrated Circuit (IC) packages on printed circuit boards is another objective. Work of the generation of specification and standards for the selection and assembly of high pincount IC packages for space applications is described. ESA

**N91-32329#** LABEN Ferranti International, Vimodrone (Italy).
**A SOLID STATE MASS MEMORY FOR SPACE APPLICATIONS: TECHNOLOGICAL AND SYSTEM ASPECTS** **c60**
F. Longoni, G. Simonetti, and A. Zambra *In* ESA, ESA Electronic Components Conference Mar. 1991 p 235-241 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A solid state mass memory for space applications is presented. High memory capability with fault tolerant design make it useful for scientific payload data storage. Technological implementation and reliability evaluation are analyzed. Advantages of Solid State Mass Memory (SSMM) over conventional sequential memory techniques are outlined. SSMM architectural aspects and technological implementation are discussed. ESA

**N91-32330#** Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
**NEW TECHNOLOGIES FOR INTEGRATING THERMAL CONTROL, AND RADIATION PROTECTION IN HYBRID TECHNOLOGY**
A. Youssef, A. Meyer, J. B. Ducrocq (Alcatel Espace, Toulouse, France ), and A. Roux *In* ESA, ESA Electronic Components Conference Mar. 1991 p 243-245 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Techniques of integrating thermal control and radiation protection in hybrid technology are outlined. Hybridation allows for significant reduction in weight and volume of subsystems. There are however, some specific constraints associated with spaceborne instrumentation, namely the temperatures met during eclipses or during missions in deep space cannot be withstood by the components, especially when they are located outside the body of the spacecraft. Very efficient thermal control is required. Radiation doses can also be a very serious constraint requiring efficient protection. The number of models is small; hence the design has to be compatible with several missions in order to decrease the cost. ESA

**N91-32331*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE NASA MICROELECTRONICS SPACE RADIATION EFFECTS PROGRAM (MSREP) AT THE JET PROPULSION LABORATORY**
C. Barnes, J. Coss, D. Nichols, and D. Shaw *In* ESA, ESA Electronic Components Conference Mar. 1991 p 249-254 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders CSCL 09C

The primary objective of the Microelectronics Space Radiation Effects Program (MSREP) at the Jet Propulsion Laboratory (JPL) is to assist NASA in the selection of radiation hardened microelectronic parts for insertion in NASA space systems through radiation testing and research. Prior to presenting examples of the research and testing on Single Event Effects (SEE) and Total Ionizing Dose (TID) effects, the space radiation environment and radiation requirements for the CRAFT/Cassini program, a typical JPL space project, are discussed. ESA

**N91-32332#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
**TEST STRUCTURES AND MEASUREMENT TECHNIQUES FOR RADIATION HARDENING**
Bengt Johlander *In its* ESA Electronic Components Conference Mar. 1991 p 255-259 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Available measurement techniques and test structures suitable for industrial radiation hardening are surveyed. The choice of such techniques for a cost and time effective implementation of a hardening program depends on problem areas found in the first base line irradiation. The technical complexity and difficulty of interpretation of the results requires an experienced device characterization engineer as part of the team. Standardization of test techniques is identified as a need for future hardening programs under ESA contract. ESA

**N91-32333#** Plessey Research (Caswell) Ltd., Towcester (England).
**EFFECTS OF DESIGN ON TOTAL DOSE CHARACTERISTICS OF ASIC TECHNOLOGIES**
D. R. Parker *In* ESA, ESA Electronic Components Conference Mar. 1991 p 261-265 Sponsored by United Kingdom Ministry of Defence Procurement Executive (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Circuits representing three separate silicon technologies are subjected to total dose environments to establish radiation tolerance levels for the respective technologies. In each case, results demonstrate a variation of tolerance relating to circuit design techniques. With the advent of gate arrays and application specific integrated circuits (ASIC), system designers often believe that all designs on a common technology have the same tolerance to radiation (total dose). Results however show considerable variation is possible and generalizations must be treated with caution. Technologies evaluated include a high performance one micron bipolar process, a digital twin well Complementary Metal Oxide Semiconductor (CMOS) process, and a mature analog CMOS process. ESA

**N91-32334#** MATRA Harris Semiconducteurs, Nantes (France).
**CALIBRATION OF ASIC LIBRARY FOR RADIATION TOLERANT SPACE APPLICATIONS METHODOLOGY AND EXPERIMENT**
T. Corbiere, M. Briet, P. Crevel, V. Stachetti, and M. Souyri (MATRA Espace, Paris-Velizy, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 267-271 (For primary document see N91-32291 24-33)
Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Application Specific Integrated Circuit (ASIC) behavior under space conditions radiation is studied. The ASIC library does not include any radiation modeling. Modeling experiments carried out on two micron two metal layer gate array ASICs are described. The methodology used in the tests is outlined. It is used to create an equivalent test methodology for one micron two metal layer technology. The results of the correlation experiments and simulations are good enough for reliably predicting the behavior of customized products. Application of the methodology to a silicon compiler is discussed. ESA

**N91-32335#** MATRA Harris Semiconducteurs, Nantes (France).
**RADIATION TOLERANT 1 MICRON CMOS TECHNOLOGY**
P. Crevel and K. Rodde *In* ESA, ESA Electronic Components Conference Mar. 1991 p 273-277 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Starting from a standard one micron Complementary Metal Oxide Semiconductor (CMOS) for high density, low power memory applications, the degree of radiation tolerance of the baseline process is evaluated. Implemented process modifications to improve latchup sensitivity under heavy ion irradiation as well as total dose effects without changing layout rules are described. By changing doping profiles in Metal Nitride Oxide Semiconductors (MNOS) and P-channel MOS (PMOS) device regions, it is possible to guarantee data sheet specification of a 64 K low power static RAM for total gamma dose up to 35 krad (Si) (and even higher values for the gate array family) without latch up for Linear Energy Transfer LET up to 115 MeV/(mg/cm squared). ESA

**N91-32336#** University Coll., Cork (Ireland). National Microelectronics Research Centre.
**TEMPERATURE COMPENSATION OF PMOS DOSIMETERS**
M. OSullivan, A. Kelleher, J. Ryan, B. ONeill, and B. Lane *In* ESA, ESA Electronic Components Conference Mar. 1991 p 281-285 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

In order to make the RADFET (Radiation Sensitive Field Effect Transistor) a more efficient form of dosimeter, it is necessary that any change in threshold voltage caused by temperature variations be eliminated or reduced as much as possible. This will allow the RADFET threshold voltage to be a direct monitor of the ionizing radiation to which it is exposed. The feasibility of eliminating such temperature variations in P channel Metal Oxide Semicondutors

(PMOS) dosimeters is examined and its implications for dosimeter accuracy are explored. ESA

**N91-32337#** Hahn-Meitner-Inst. G.m.b.H., Berlin (Germany, F.R.).
**DISPLACEMENT THRESHOLD ENERGY IN GaAs DETERMINED BY ELECTRICAL AND OPTICAL INVESTIGATIONS**
B. Lehmann, M. A. Briere, D. Braeunig, and A. L. Barry (National Research Council of Canada, Ottawa, Ontario ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 287-292 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A new variation of the DLTS (Deep Level Transient Spectroscopy) technique compares the energy dependence of GaAs displacement damage with results obtained by electroluminescence measurements. Both methods yield the same energy dependence, with an absolute kinetic threshold energy of about 9 eV, and an effective threshold of circa 15.5 eV, for displacement of an arsenic atom. This result is obtained for both n and p GaAs in the greater than or less than 100 direction. Results are compared with the literature, and modeled with different displacement probability functions. Agreement is obtained by taking the anisotropy of GaAs into account. Anisotropy leads to a tailing off in the displacement cross section at energies below 15 eV in the greater than or less than 111 direction, indicating that the direction is more vulnerable to displacement damage than the greater than or less than 100 direction. ESA

**N91-32338#** Hahn-Meitner-Inst. G.m.b.H., Berlin (Germany, F.R.).
**TOTAL DOSE EFFECTS IN MOS SYSTEMS: INFLUENCE OF THE INITIAL HYDROGEN DISTRIBUTION**
M. A. Briere, R. Radke, and D. Braeunig *In* ESA, ESA Electronic Components Conference Mar. 1991 p 293-298 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Resonant Nuclear Reaction Analysis (NRA) is applied to the measurement of hydrogen distributions in Metal Oxide Semiconductor (MOS) structures. The bulk oxide H content for (100 nm) dry oxides in Al gate systems is found to vary from 0.2 to 4 over 10 to the 15th power sq cm. A correlation between the H content in the oxide and that at the Al-SiO2 interface suggests that much of the H is sourced by the nearly uncontrollable contamination layer, formed on the oxide surface prior to Al evaporation. Analysis of the H profiles suggests the diffusion of water or OH during annealing. First results are presented for polySi gate samples, exhibiting 6 to 7 ten to the 12th power per sq cm H within the 100 nm dry oxide. An upper limit of 10 to the 13th power and 4 to the 11th power per sq cm H at the Si-SiO interface is established for samples with (Al gate) and without (polySi gate) heat treatments in H respectively. A positive linear correlation between the oxide H content and radiation generated oxide charges is found, as is an apparent superlinear increase of radiation induced interface states with increasing bulk oxide H content. ESA

**N91-32339#** Sira Inst. Ltd., Chislehurst (England).
**SPACE RADIATION EFFECTS ON CCDs**
Gordon R. Hopkinson *In* ESA, ESA Electronic Components Conference Mar. 1991 p 301-306 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The effects of the space radiation environment on Charge Coupled Devices (CCDs) are discussed. Data obtained from CCDs made by EEV Ltd and Thompson-CSF is presented. Two types of Thompson-CSF devices (the 288 by 385 pixel TH7863 and the 14 by 14 pixel THX31160-1) are irradiated with Co-60 gamma rays and protons (1.5 and 10 MeV). In both cases significant increases in dark current are observed which continue after irradiation has ceased with increased reverse annealing for regions of the CCD covered by an aluminum light shield, but reduced damage for proton rather than Co-60 irradiation. Threshold voltage shift of approximately 0.1 V/Krad are produced. Results of proton irradiation of EEV devices are considered. The majority of measurements on both manufacturers' devices are carried out at room temperature and no degradation of charge transfer efficiency is observed (though the measurement accuracy is limited to 0.99995 per pixel transfer). ESA

**N91-32340#** Leicester Univ. (England). X-Ray Astronomy Group.
**FURTHER PROTON DAMAGE EFFECTS IN EEV CCDs**
A. Abbey, A. Holland, D. Lumb, and K. McCarthy *In* ESA, ESA Electronic Components Conference Mar. 1991 p 307-318 (For primary document see N91-32291 24-33)
(Contract ESTEC-8093/88/NL/SK)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A large number of spaceborne observatories have been proposed for which the detecting systems rely on Charge Coupled Device (CCD) imagers for the sensing function. The orbits of these missions will have different radiation environments, but most will encounter highly ionizing protons which cause degradation of the charge tranfer performance, which is a critical parameter for X-ray spectroscopic applications. Measurements of the degradation as a function of incremental dose, temperature of irradiation and of proton energy are described for different device architectures, including structures designed to minimize the interaction between signal charge and trapping sites. Charge transfer degradation at doses of as little as 100 rads (6 MeV protons) is measured. The increase in dark current with proton dose is described. Implications for future astrophysics missions are discussed. ESA

**N91-32341#** Thomson-CSF, Bagneux (France).
**TOTAL DOSE EFFECTS ON CHARGE COUPLED DEVICES (CCD) REVERSE ANNEALING PHENOMENA**
J. C. Boudenot and P. Augier *In* ESA, ESA Electronic Components Conference Mar. 1991 p 319-324 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Results concerning the total dose effect on CCDs are presented. The major effect is an increase of dark current which is observed even after termination of irradiation under all test conditions (sources, dose rate, polarization). It is a case of reverse annealing phenomena, like rebound or superrecovery. In this case the post irradiation effect affects the dark current rather than threshold voltage. An experimental means of testing for the origin of the reverse annealing is described. ESA

**N91-32342#** Saab Space A.B., Goeteborg (Sweden). Components Lab.
**RADIATION ASSESSMENT OF COMPLEX TECHNOLOGIES**
S. Mattsson *In* ESA, ESA Electronic Components Conference Mar. 1991 p 327-332 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Test strategies to guarantee adequate fault coverage and reliability of Very Large Scale Integration (VLSI) circuits in a radiation environment are more extensive and much more complicated than for less complex Integrated Circuits (ICs) such as Small Scale Integration (SSI) and Medium Scale Integration (MSI) devices. Several different approaches have been used in the past to assess the vulnerability of microprocessors to Single Event Upsets (SEU). Methods and strategies for radiation testing of microprocessors are discussed. Total dose and SEU results from tests of the microprocessors Motorola 68020 and Intel 80386 are presented. ESA

**N91-32343#** International Business Machines Corp., Manassas, VA.

**SINGLE EVENT TEST METHOD AND TEST RESULTS ON THE INTEL 80386**

Thomas Mark Scott *In* ESA, ESA Electronic Components Conference Mar. 1991 p 333-338 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The technique and results of radiation susceptibility testing performed on the Intel 80386 microprocessor are described. Latchup and upset sensitivities are evaluated using alpha particles, heavy ions and protons, as well as some total dose test results. Californium and heavy ion testing yield virtually identical results. No transients are discovered using californium or heavy ions, but the extended range of the heavy ion facility picked up a latchup mechanism. ESA

**N91-32344#** Centre National d'Etudes Spatiales, Toulouse (France).

**RADIATION SENSITIVITY OF POWER MOSFETS**

J. Garnier and P. Tastet *In* ESA, ESA Electronic Components Conference Mar. 1991 p 339-343 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Metal Oxide Semiconductor Field Effect Transistors (MOSFETS) are widely used in space applications. Their high speed switching capability and easy voltage gate control allow large gain in efficiency and mass of on board power supplies. However, these components are sensitive to radiation. In order to quantify this sensitivity, various tests (total dose and heavy ions) are performed on international rectifier MOSFETS. Two families are evaluated: the ESA/SSC qualified standard technology and radiation tolerant technology. It is concluded that in most cases a negative gate source bias is not necessary to ensure the blocking of the transistor. ESA

**N91-32345#** Centre National d'Etudes Spatiales, Toulouse (France).

**TRENDS IN LATCH-UP SENSITIVITY**

T. Chapuis, L. H. Rosier, and H. Constans (Etudes, Realisations Electroniques et Micro-Systemes, Toulouse, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 347-350 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

New space projects tend to use more and more Very Large Scale Integration (VLSI) circuits manufactured in Complementary Metal Oxide Semiconductor (CMOS) technology. Assessment of latchup sensitivity is mandatory in the evaluation plan of a component, and in some cases the result could be considered as a GO/NOGO parameter. Data on several CMOS/epilayer devices is presented demonstrating the non efficiency of an epitaxial layer to achieve latchup immunity for some technologies used. ESA

**N91-32346#** Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France).

**SINGLE EVENT UPSET SENSITIVITY OF A SRAM: AN OVERVIEW FROM TESTING PROCEDURES TO DEVICE HARDENING (THEME 2)**

O. Musseau, J. L. Leray, Y. M. Coic, and Y. Patin *In* ESA, ESA Electronic Components Conference Mar. 1991 p 351-356 (For primary document see N91-32291 24-33)

(Contract CNES-CEA-844/87/4757/00)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The single event upset sensitivity of Complementary Metal Oxide Semiconductors (CMOS) on epilayer 16 and 64 kbit Static RAM's (SRAMS) is studied. The device cross sections are measured using both a californium source and accelerator beams. The experimental results are complemented by numerical simulations of the transients in a memory cell under various conditions, and a simplified model of charge collection in CMOS on epilayer is proposed. Analysis of the topological sensitivity of memory cells suggests simple hardening techniques that do not modify the technological process. The data reveals an unexpected failure mode. Device testing validity with various accelerators is discussed. ESA

**N91-32347#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**HEAVY-ION INDUCED SINGLE-EVENT UPSET IN INTEGRATED CIRCUITS**

J. A. Zoutendyk *In* ESA, ESA Electronic Components Conference Mar. 1991 p 357-361 Sponsored by NASA Microelectronics Space Radiation Effects Program (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The cosmic ray environment in space can affect the operation of Integrated Circuit (IC) devices via the phenomenon of Single Event Upset (SEU). In particular, heavy ions passing through an IC can induce sufficient integrated current (charge) to alter the state of a bistable circuit, for example a memory cell. The SEU effect is studied in great detail in both static and dynamic memory devices, as well as microprocessors fabricated from bipolar, Complementary Metal Oxide Semiconductor (CMOS) and N channel Metal Oxide Semiconductor (NMOS) technologies. Each device/process reflects its individual characteristics (minimum scale geometry/process parameters) via a unique response to the direct ionization of electron hole pairs by heavy ion tracks. A summary of these analytical and experimental SEU investigations is presented. ESA

**N91-32348#** Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et Recherches en Technologie Spatiale.

**CECIL: COLLABORATION BETWEEN COMPANIES AND RESEARCH AGENCIES IN HEAVY ION TEST OF SPACECRAFT MICROELECTRONICS**

S. Duzellier, T. Chapuis, and C. Dufour (MATRA Espace, Buc, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 363-367 (For primary document see N91-32291 24-33)

Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

With new technologies, high integration levels of spatial components, Single Event Effects (SEE) are becoming of major concern for spacecraft reliability. To access the vulnerability of any device to SEE, experimental measurements and tests using heavy ions accelerators must be carried out. Problems encountered by test engineers performing such investigations are discussed. Space environment simulation, spatial components diversity and complexity, development of specific test facilities and programs are some of the areas considered. The decision to create an operating group called CECIL in order to face these problems is discussed. Heavy ions facilities and a summary of irradiation test results are presented and discussed. The role to be played by the CECIL organization in promoting progress in test capabilities is outlined. ESA

**N91-32349#** Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et Recherches en Technologie Spatiale.

**SINGLE EVENT EFFECTS BY PROTONS ON LOW EARTH ORBITS: A PROBLEM FOR EUROPEAN MANNED SPACE MISSIONS** **c93**

J. Bourrieau and T. Bion (MATRA Harris Semiconducteurs, Nantes, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 369-376 (For primary document see N91-32291 24-33)

Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Nuclear reaction modeling and experimental data on heavy ion cross section variations versus Linear Energy Transfer (LET) are used to determine device sensitivity to proton induced Single Event Effects (SEE). In order to verify the validity of the method, computations are performed for the Fairshild 93L422 and Intel 2164A memories for which heavy ion test data are available. The

proton induced SEE cross sections obtained are compared with other theoretical results and with ground based experimental data. Upset rates measured onboard UOSAT 2 and experimental data on heavy ions cross sections, available for HM6564 and HM6516 memories are used in order to verify all the steps involved in the forecast of trapped proton induced SEE rate. The results obtained are in good agreement with the inflight observed rates. ESA

**N91-32350#** ABB Hafo A.B., Jaerfaella (Sweden).
**ANALOG CMOS/SOS IN RADIATIVE ENVIRONMENTS**
Magnus Paulsson *In* ESA, ESA Electronic Components Conference Mar. 1991 p 379-385 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A radiation tolerant Silicon On Sapphire (SOS) process used to produce Complementary Metal Oxide Semiconductor Application Specific Integrated Circuits (CMOS ASIC's) is described. Use of such analog/digital CMOS/bulk ASIC's in pacemakers and hearing aids is discussed. Recent development on the SOS process now makes it possible to make radiation hard analog designs as well. The SOS4 process and its analog opportunities are discussed. The SOS4 technology in general is presented and its advantages and drawbacks are discussed. Radiation effects on CMOS/SOS devices are presented in order to understand their impact on analog design. Performance results from a high speed comparator and a charge amplifier show different useful aspects of the SOS4 process. ESA

**N91-32351#** Marconi Electronic Devices Ltd., Lincoln (England).
**SIMULATION OF RADIATION INDUCED CIRCUIT FAILURE MODES IN SOS INTEGRATED CIRCUITS**
G. C. Townsend and S. A. Bird *In* ESA, ESA Electronic Components Conference Mar. 1991 p 387-391 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The design of radiation hard integrated circuits is discussed. The complex interaction between the several distinct effects of radiation on an individual transistor's characteristic is considered. Existing simulations often examine only one effect at any one time, and then in a crude global manner. The task of predicting the combined effects of these phenomena on a circuit as a whole is difficult, and as a result critical circuit failure mechanisms can often be overlooked. The major radiation effects with which the designer is concerned and some techniques used to predict their combined effect using the SPICE circuit simulator are described. An example of some of the results of this kind of analysis are presented, together with some conclusions drawn from them. Suggestions for future improvements in modeling and simulation techniques are made. ESA

**N91-32352#** Ibis Technology Corp., Danvers, MA.
**THE ADVANTAGES OF SILICON-ON-INSULATOR TECHNOLOGIES FOR SPACE ENVIRONMENTS**
W. A. Krull and S. J. Gaul (Harris Semiconductor, Melbourne, FL.) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 393-397 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The use of integrated circuits for space applications requires technologies that address the hostile environment present in space. This environment includes exposure to radiation and high energy particles. In addition, contraints related to temperature, weight, and reliability are imposed by the system requirements. Silicon On Insulator (SOI) technology is uniquely suited in these applications due in part to its improved Single Event Upset (SEU) performance compared to bulk technologies. Other advantages of SOI include reduced standby current and operation over a wider temperature range resulting from the elimination of the substrate isolation junction. The benefits of SOI for space applications are discussed with examples cited from both bipolar and CMOS devices and circuits. ESA

**N91-32353#** Marconi Electronic Devices Ltd., Lincoln (England).
**SOS MATERIAL IMPROVEMENT FOR POST TOTAL DOSE, RADIATION INDUCED LEAKAGE REDUCTION**
J. A. Kerr, R. J. Charig, and C. M. Shaw *In* ESA, ESA Electronic Components Conference Mar. 1991 p 399-403 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Work carried out to determine the effect of Silicon On Sapphire (SOS) wafer fabrication process on radiation induced leakage in SOS devices is described. The experimental material matrix studied includes various sapphire substrate pre-epitaxy annealing schedules, coupled with variable epitaxial deposition temperatures and rates. The material is assessed using ultraviolet reflectance coupled with sample X-ray analysis. The CMOS-SOS SRAM (Static RAM) circuits together with tests structures are then fabricated using Marconi Electronic Devices Ltd. (MEDL) 3 and 1.5 micron technologies. The N and p channel transitor transfer characteristics are measured, before and after irradiation in an Aracor X-ray source at up to 1,000,000 rad SiO2 total dose. The results show a dramatic reduction in post radiation leakage levels on both devices and the associated SRAM circuits. ESA

**N91-32354#** Hahn-Meitner-Inst. G.m.b.H., Berlin (Germany, F.R.).
**TOTAL DOSE STUDY ON LS-, ALS, AND F-TECHNOLOGY INTEGRATED CIRCUITS**
F. Wulf (Interuniversity Micro-Electronics Center, Leuven, Belgium), A. Boden, and D. Braeunig *In* ESA, ESA Electronic Components Conference Mar. 1991 p 407-412 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Total dose failure levels of digital bipolar microcircuits (Low Power Schottky (LS), Advanced LS (ALS), and Fast (F) technology) are investigated in a total dose range up to 80 Mrad (Si). The irradiation is performed by using a 2.5 MeV electron accelerator to study the ionizing and displacement damage of the devices. The dose rate is varied from 5 to 3.2 thousand rad Si over s depending on the total dose step. The annealing behavior is studied after 48 h after several weeks. The DC and pulse characteristics as well as functional tests under different parameter settings are performed. Device failure levels are found to vary by orders of magnitude depending on bias conditions during irradiation, device type, and technology. ESA

**N91-32355#** Hahn-Meitner-Inst. G.m.b.H., Berlin (Germany, F.R.).
**IRRADIATION TESTS AND RADIATION HARDNESS PREDICTION CONSIDERATIONS ON ELECTRONIC COMPONENTS FOR SPACE APPLICATION**
A. Boden, F. Wulf (Interuniversity Micro-Electronics Center, Leuven, Belgium ), and D. Braeunig *In* ESA, ESA Electronic Components Conference Mar. 1991 p 413-418 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The different damage mechanisms that are of significance in a space environment and the sensitivity of the device families to them are discussed. An approach to advanced irradiation qualification tests is discussed. A brief description of the test activities at the Hahn-Meitner-Institute (HMI) is given. Since 1972, the HMI has been engaged in radiation qualification of electronics for space applications. On the basis of the large number of devices that were tested and on the great variety of technologies and functions involved, it was empirically determined to be very difficult to develop a unified model for the prediction of irradiation behavior. The current standards and specifications which prescribe how radiation testing has to be performed are not sufficient to cover all problems. ESA

**N91-32356#** Commissariat a l'Energie Atomique, Gif-sur-Yvette (France). Dept. d'Electronique et Instrumentation Nucleaire.
**MEASUREMENTS OF PROTON UPSET INDUCED IN CMOS DEVICES: SYNTHESIS OF CEA STUDIES**
D. Mijuin, J. Buisson, T. Chapuis (Centre National d'Etudes Spatiales, Toulouse, France ), Jean-Pierre Brunet, J. Murat, and G. Milleret *In* ESA, ESA Electronic Components Conference Mar. 1991 p 419-426 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The behavior of electronic components submitted to the type of radiation encountered in Earth orbits or by planetary probes is studied. A synchrotron designed for basic research in the physics of light particles and heavy ions of intermediate energy, SATURNE, is used in the study. The energy supplied to the protons lies between 0.2 and 2.9 GeV with an intensity larger than 10 exp 12 protons per cycle. During the experiment and in order to lower the proton energy under 200 MeV, an Al absorber is used. The flux measurement is obtained by two different methods: measurement by activation and measurement by counting (scintillator coupled with a pressurized module). The increased number of upsets during irradiation is determined on line, for each cycle, by a tester using a comparative hardware method. The upset cross sections obtained for a variety of static memories using the method described are presented. ESA

**N91-32357#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Components Div.
**THE PRE-SCREENING OF LARGE SEMICONDUCTOR MEMORIES FOR SPACE APPLICATION** **c60**
R. Harboe-Soerensen and R. Mueller (Technische Univ., Brunswick, Germany, F.R. ) *In its* ESA Electronic Components Conference Mar. 1991 p 427-433 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A cost effective radiation prescreening program using an IDA designed memory test system and the ESTEC Co-60 and californium 252 irradiation facilities is described. Total ionizing dose and single event upset latch up results on a large number of different state of the art memory devices are presented. Details are provided of test equipment, test strategy, and test techniques, and a number of high density memory device types are identified as suitable for further evaluation. ESA

**N91-32358#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
**RADIATION ASSESSMENT OF THE INMOS TRANSPUTER FAMILY** **c60**
M. LopezCotarelo, J. A. Thompson, B. K. Hancock, and J. P. Nicholls (Satellites International Ltd., Newbury, England ) *In its* ESA Electronic Components Conference Mar. 1991 p 435-440 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Total dose radiation tests using the ESTEC Co-60 gamma ray source are performed on several devices on the INMOS transputer family; the INMOS T800, T222, and T245 transputers. Results show functional failure between 3 to 4 Krad (Si) when the tests are performed with the devices powered up and the on chip memory enabled. Tolerance to gamma irradiation increases in all cases when the internal memory of the transputers is disabled. Under such conditions, the lowest doses measured when functional failure occur are 8 Krad for the T222, 13 Krad for the T425, and 43 Krad for the T800. This last result was obtained on a single sample; therefore, lower values should be allowed for when considering the large spread observed in the results from T222 and T425 for devices belonging to different batches. In addition to this, proton induced Single Event Upset (SEU) response is studied on INMOS T800. The SEU's are observed only when testing the internal memory of the device. ESA

**N91-32359#** Sextant Avionique, Valence (France). Dept. Microelectronique.
**CHARACTERIZATION OF 256 Kbits SRAMs UNDER CALIFORNIUM 252 AND PROTONS IRRADIATIONS**
Patrice L. Chabannes, Jean-Marie Hess, Jacques Buisson, and Jean Pierre Brunet (Commissariat a l'Energie Atomique, Gif-sur-Yvette, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 441-445 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Results of two experiments carried out on 256 Kbits Complementary Metal Oxide Semiconductors (MOS) resistive load Static Random Access Memories (SRAM'S) with and heavy ion radiation are presented. The tests are conducted on ten different types of nonradiation hardened devices, even though some manufacturer could provide available hardened technologies. Single Event Upset (SEU) cross sections recorded under 1 GeV protons and Cf-252 heavy ions exposures are presented. Saturation cross sections are unavailable using Cf-252 heavy ions because they could not reach deeper sensitive zones of the dies. ESA

**N91-32360#** Thomson and Nielsen Electronics, Ottawa (Ontario).
**ADVANCES IN SEM BEAM MICRO-IRRADIATION**
I. Thomson, G. Mackay, and R. Haythornthwaite (QRL Analysis Corp., Ottawa, Ontario ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 447-450 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

An instrument designed to measure the dose deposited by the beam under routine irradiation conditions using Metal Oxide Semiconductor Field Effect Transistor (MOSFET) dosimeter cells is described. The dosimeter response is calibrated against various types of radiation sources to enable intercomparisons with Co-60, electrons and protons. The technique enables Scanning Electron Microscope (SEM) users to carry out micro-irradiations of operating devices. ESA

**N91-32361#** Centre National d'Etudes Spatiales, Toulouse (France).
**EVALUATION OF FPGAs**
R. M. Ecoffet *In* ESA, ESA Electronic Components Conference Mar. 1991 p 451-455 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Field Programmable Gate Arrays (FPGA) and standard user programmable logic devices are discussed. With a gate count of 1000 to 10,000 or more, they stand between PLD's and Application Specific Integrated Circuits (ASIC's) and are very well adapted to prototyping or short and low cost developments. These advantages present FPGA's as interesting components for some space applications. The XILINX Logic Cell Arrays (LCA's) are studied. A single phenomenon check is carried out before a more detailed evaluation. The method of testing, the test system, and the test board are described. The Cf 252 and heavy ion results are presented. An estimation of error states for different orbits is made. ESA

**N91-32362#** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsion Systems Div.
**TOTAL DOSE CHARACTERIZATION OF NEW COMPONENTS FOR THE ESA RADIATION EFFECTS DATABASE**
Ole Pedersen, Michael Regula, Rolf Rieger, J. Farren, and S. Johnson (Spur Electron Ltd., Havant, England ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 457-464 (For

primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The ESA radiation effects data base project, launched by ESA/ESTEC in early 1989 is described. The varying degree of radiation hardness requirements of different ESA space projects covering both total dose and cosmic ray effects (Single Event Upsets (SEU) and latchup) forms the basis of the radiation effects data base, which contains data for adequate predictions. The status of the project is presented along with the experimental results of total dose characterization tests. Although some of the component test data has been published by various sources, details about test conditions and parameter measurements are presented together with supporting information regarding device technology, data code, lot date code, etc. ESA

**N91-32363#** Universite des Sciences et Techniques du Languedoc, Montpellier (France). Centre d'Electronique de Montpellier.
**SPACE RADIATION EFFECTS ON POWER MOSFET: THRESHOLD-VOLTAGE SHIFT WITH DOSE RATE**
G. Bruguier, M. Castel, J. P. Charles, J. Gasiot, and P. Calvel (Alcatel Espace, Toulouse, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 465-467 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The threshold voltage variation of power Metal Oxide Semiconductor Field Effect Transistors (MOSFETS) at various dose rates is studied. A description of the experimental set up is given. The results obtained for four tansistor types and four different dose rates are presented. Unpredictable results are obtained for one batch of IRFF 110. The abnormal behavior is determined to be due to the fabrication batch. No other explanation can be found for the unpredictable behavior. ESA

**N91-32364#** Universite des Sciences et Techniques du Languedoc, Montpellier (France). Centre d'Electronique de Montpellier.
**LASER HEATED CALCIUM SULFATE TLD PLATES: APPLICATION TO RADIATION MAPPING** **c35**
K. Ed-Dahabi, F. Loup, O. Missous, G. Bruguier, H. Prevost, J. Fesquet, and J. Gasiot *In* ESA, ESA Electronic Components Conference Mar. 1991 p 469-472 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A method of radiation mapping using laser heated Thermo Luminescence Dosimetry (TLD) plates made of CaSO4:Mn is described. The thermoluminescent properties of this material applied to dose mapping are presented and an example of dose mapping in the radiation field is given. The results indicate that the method is suitable for radiation mapping applied to dosimetry for electronics. Large size dosimeters are not considered a problem as the material and its support are less heated and stressed as well as faster processed. ESA

**N91-32365#** Selenia Spazio S.p.A., Rome (Italy).
**RESULTS AND CONSIDERATIONS ON FAILURE INVESTIGATIONS OF COMPONENTS USED FOR SPACE EQUIPMENT** **c38**
G. Tommaso *In* ESA, ESA Electronic Components Conference Mar. 1991 p 475-480 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The major findings and considerations derived from failure investigations of components used by Selenia Spazio during manufacturing of space equipment (flight and qualification models) are presented. The period taken into account includes equipment manufactured for the projects Olympus, Meteosat, Italsat, TSS, Hipparcos, and ERS-1. A data base is presented, which includes the information for each component submitted to a failure investigation. Some statistics from the data base are highlighted. Component types or families in which noncomformity most frequently occurs are identified. Failure modes due to electrical, mechanical, and thermal stress are identified. Various examples of failure modes are reported. They can be grouped according to different cases on the basis of the results obtained upon completion of failure investigation. Possible corrective actions are described. An overview of critical aspects for each component family is reported. ESA

**N91-32366#** Arge-Detecon, Bonn (Germany, F.R.).
**EXPERIENCES WITH COMPONENTS IN THE DFS-PROJECT: SEEN FROM A CUSTOMER'S POINT OF VIEW**
D. Johst *In* ESA, ESA Electronic Components Conference Mar. 1991 p 481-483 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Experiences with components in the German telecommunications satellite project DFS are addressed. The nature of most problems related to product assurance is that they occur late in the programs. Sometimes they occur so late, that corrective measures have a considerable risk impact on the customer and a considerable financial impact on the contractor. It is recommended that the activities in the field of product assurance be intensified and accelerated at the source, the component manufacturer, in order to avoid these problems in the future and benefit both contractor and customer. ESA

**N91-32367#** Centre National d'Etudes Spatiales, Toulouse (France). Components Div.
**SUMMARY OF EEE COMPONENT ANOMALIES ENCOUNTERED IN THE SPOT LINE OF EARTH OBSERVATION SATELLITES AND LESSONS DERIVED THEREFROM FOR FUTURE GENERATIONS**
F. Linder, S. Ponomarenko, D. Lacroix, and X. Penou *In* ESA, ESA Electronic Components Conference Mar. 1991 p 485-490 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The results of Electric, Electronic, and Electromechanical (EEE) component activities applied to French Earth observation satellites of the SPOT family are discussed. The SPOT program and the different satellites in the family are described. Emphasis is given to the components used. The component selection policy is described and results are given in terms of number of types, manufacturers, and quantities used. Details concerning the procurement of SPOT components in terms of screening, quality levels, and procurement aspects are reviewed. Component incidents and problems encountered during the development of SPOT satellites are discussed. The details and analysis of all incidents are given. Actions taken for the next generation of satellites are presented. ESA

**N91-32368#** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsion Systems Div.
**A STATISTICAL EVALUATION OF EEE-PARTS PROCUREMENT DATA FROM TELECOMMUNICATION SATELLITES**
E. Purr *In* ESA, ESA Electronic Components Conference Mar. 1991 p 491-498 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

High reliability Electric, Electronic, and Electromechanical (EEE) parts procurement data from six telecommunication satellite projects are statistically evaluated. For comparison purposes, data from a scientific satellite project are included. Problems relating to procurement cost and timescale reduction and the continuing necessity to procure 50 percent (by cost) of all parts from U.S. manufacturers are identified. A number of actions are proposed to solve these problems. ESA

**N91-32369#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**AN OVERVIEW OF THE NASA ELECTRONIC COMPONENTS INFORMATION MANAGEMENT SYSTEM c82**
G. Kramer and S. Waterbury *In* ESA, ESA Electronic Components Conference Mar. 1991 p 499-502 (For primary document see N91-32291 24-33)
Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The NASA Parts Project Office (NPPO) comprehensive data system to support all NASA Electric, Electronic, and Electromechanical (EEE) parts management and technical data requirements is described. A phase delivery approach is adopted, comprising four principal phases. Phases 1 and 2 support Space Station Freedom (SSF) and use a centralized architecture with all data and processing kept on a mainframe computer. Phases 3 and 4 support all NASA centers and projects and implement a distributed system architecture, in which data and processing are shared among networked database servers. The Phase 1 system, which became operational in February of 1990, implements a core set of functions. Phase 2, scheduled for release in 1991, adds functions to the Phase 1 system. Phase 3, to be prototyped beginning in 1991 and delivered in 1992, introduces a distributed system, separate from the Phase 1 and 2 system, with a refined semantic data model. Phase 4 extends the data model and functionality of the Phase 3 system to provide support for the NASA design community, including integration with Computer Aided Design (CAD) environments. Phase 4 is scheduled for prototyping in 1992 to 93 and delivery in 1994. ESA

**N91-32370#** Components Technology Inst., Inc., Huntsville, AL.
**THE HISTORY OF SPACE QUALITY EEE PARTS IN THE UNITED STATES c38**
Leon Hamiter *In* ESA, ESA Electronic Components Conference Mar. 1991 p 503-506 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Major and subtle characteristics which make space quality parts different than military, commercial or automotive parts are discussed. Very few Electrical, Electronic and Electromechanical (EEE) parts are specifically designed for space applications due to the low volume and sporadic purchasing/manufacturing requirements. The difficulty and apparent high cost of obtaining true space quality parts have caused many space programs to pursue short cuts such as upgrading lower quality parts through testing and taking risks on using lower quality parts as they are. Historical milestones in the development of space quality parts in the U.S., some cost examples when space quality parts were not used and some good practices for reliable space quality EEE parts are reviewed. ESA

**N91-32371#** Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
**RATIONALES FOR THE SELECTION OF A PARTS PROCUREMENT SYSTEM (COORDINATED VERSUS CENTRALIZED) FROM A PRIME CONTRACTOR POINT OF VIEW**
G. Stamerjohanns *In* ESA, ESA Electronic Components Conference Mar. 1991 p 509-513 Prepared in cooperation with Erno Raumfahrtechnik G.m.b.H. (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

In spite of the significant variation in size and number of contractors involved in different space programs the major prime contractor goals and responsibilities remain similar. Electrical, Electronic and Electromechanical (EEE) parts procurement related problems experienced during the majority of past programs have led to program delays and excessive, underestimated program cost. In order to minimize such program impacts, experience gained and lessons learnt are used to trade off different EEE parts procurement approaches. Centralized procurement is compared to coordinated procurement. The results of this trade off approach are used to plan, structure and implement the centralized procurement approach selected for the Columbus program. ESA

**N91-32372#** Spur Electron Ltd., Havant (England).
**EEC COMPONENT PROCUREMENT: A LOOK AHEAD c81**
M. Snowdon *In* ESA, ESA Electronic Components Conference Mar. 1991 p 515-517 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

It is demonstrated that a properly managed Electrical, Electronic and Electromechanical (EEE) component procurement program not only provides components of a quality and reliability standard which meet or exceed project requirements, but surpasses project aims in a cost and schedule effective manner. A number of key areas associated with an EEE parts procurement program are discussed. The ESA/SCC specification system, various types of procurement approaches and the role of the procurement agents are reviewed. A number of recommendations are made which, if implemented will further improve upon the successes achieved to date. ESA

**N91-32373#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Components Div.
**ESA's COMPONENT PROGRAMME PLAN c81**
U. Ernsberger *In its* ESA Electronic Components Conference Mar. 1991 p 519-522 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A critical review of the actual methods, procedures and concepts applied to the procurement, assurance and control of components for space application is presented. The result of this review is reflected in the ESA components program plan which aims at enhancing the availability of advanced component technology for forthcoming space programs and providing a solid technology platform in Europe. The main elements of the plan including ESA component policy and long term objectives are described. Efforts in research, technology, standardization and related infrastructure are outlined. ESA

**N91-32374*#** National Aeronautics and Space Administration, Washington, DC.
**NASA's CHALLENGE FOR TOMORROW c81**
Daniel L. Barney *In* ESA, ESA Electronic Components Conference Mar. 1991 p 523-529 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders CSCL 09C

The early space probes provided our first detailed look at the planets, and demonstrated the critical role played by parts technology. The advanced orbital platform under development, the Space Station Freedom (which represents a pivotal step in the space program) contains about 5 million Electrical, Electronic and Electromechanical (EEE) parts. Thus, EEE parts continue to be crucial to mission success. The NASA EEE parts program establishes and directs policy and integration throughout the Agency. The EEE program structure, issues and solutions are described. The challenge presented by advanced electronic devices is discussed. ESA

**N91-32375#** TRW Components International, Inc., Torrance, CA.
**PARTS MANAGEMENT FOR THE 1990's c81**
S. Jennings and M. Scott *In* ESA, ESA Electronic Components Conference Mar. 1991 p 531-534 (For primary document see N91-32291 24-33)
Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Space Programs of the 1990's are predicted to present demands upon parts management more difficult than in time past. There will be increased management pressure to lower the cost

of space systems. Cost effective solutions must be found. Changes that influence the 1990's environment are discussed. Some examples that can be effective in dealing with these issues are presented. ESA

**N91-32376#** IGG Component Technology Ltd., Portsmouth (England).
**UPSCREENING OF COMPONENTS FOR SPACE APPLICATIONS** **c81**
R. Fidler *In* ESA, ESA Electronic Components Conference Mar. 1991 p 537-544 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The term upscreening is used to describe additional testing performed on military or similar components to obtain a level of confidence and to justify acceptance for space usage. Upscreening is carried out when a space program cannot obtain components through usual procurement methods due for example to component lot failure, or to the reluctance of a single source manufacturer to accept a high reliability order. Most space programs are obliged to use a small percentage of upscreened components. For a recent satellite project, upscreening was performed on some 130 different part types. The part types upscreened, the testing performed and a summary of the results obtained are presented. Some of the results which are different than those expected are examined in detail. Conclusions are drawn which prove the validity of upscreening for use in extreme circumstances. ESA

**N91-32377#** Tecnologica S.A., La Laguna (Spain).
**SPACE FLIGHT COMPONENTS DATABASE [BASE DE DONNEES POUR COMPOSANTS HAUTE FIABILITE]** **c82**
Jose M. Galdo and Jose A. Izquierdo *In* ESA, ESA Electronic Components Conference Mar. 1991 p 545-547 In SPANISH (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A space flight components data base is described. The data base included information on high fidelity components not found in manufacturers' data books. Technological data, component description, specifications and radiation tolerance of high fidelity components are included in the data base. Qualification status, flight histories, evaluation results, failure analysis and other quality related data are included. Commercial aspects such as delivery time and munufacturer information are presented. ESA

**N91-32378#** IGG Component Technology Ltd., Portsmouth (England).
**THE MERITS OF AN INDEPENDENT PRE-CAP INSPECTION** **c38**
J. A. Jones *In* ESA, ESA Electronic Components Conference Mar. 1991 p 549-554 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Results of routine destructive physical analysis carried out on monolithic integrated circuits are presented. Circuits meant to meet MIL-STD-883 level B screening flow show consistent failure under destructive physical analysis tests. Potential reliability hazards associated with this failure are discussed. It is concluded that little reliance can be placed on manufacturers to perform pre-cap inspection and wafer-Scanning Electron Microscope (SEM) acceptance if there is no independent monitoring. SEM photographs are shown of representative manufacturing defects in the circuits tested. ESA

**N91-32379#** Tecnologica S.A., La Laguna (Spain).
**CPFS: THE TOTAL INFORMATION SYSTEM TOOL FOR EEE-PARTS PROCUREMENT** **c81**
F. Garrido *In* ESA, ESA Electronic Components Conference Mar. 1991 p 555-560 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The philosophy used in the development and design of the CPFS system and the advantages that a system of this nature presents are discussed. The high number of EEE (Electrical, Electronic and Electromechanics) parts which are needed for a given project along with the detailed technical and administrative definition, demands perfect management of the information that is generated for each single item of a project's part list. CPFS is a rationalized computing system which takes into account that a medium size project handles hundreds of different items each of which has its own identity. The handling of the technical, cost and schedule information, requires a computerized process which guarantees the quality of the information managed in two different and fundamental aspects: information reliability and traceacibility. ESA

**N91-32380#** Plessey Research (Caswell) Ltd., Towcester (England).
**COMPONENT FIELD FAILURE DATA BASE** **c82**
G. M. Brydon and J. A. Hayes (Loughborough Univ. of Technology, England ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 561-565 Sponsored by United Kingdom Ministry of Defence Electronic Components Group (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A program of work carried out to collate information on field failure of components obtained from equipment in the field is presented. The information is acquired from equipment failures within the United Kingdom and Denmark. The data is stored on a database at the International Reliability Institute of Loughborough University of Technology responsible for organizing, storing and analyzing the results. The Danish data is all processed through the Danish Engineering Academy. The data is stored on the University Hewlett Packard mainframe and uses an ORACLE database management system. The format of the assembled data is described and comparisons made on the behavior of component categories. A summary of the data assembled to date is given together with some analysis of the results. The analysis shows that in some cases the constant failure rate assumption is not valid for many components. This leads to an improved understanding of reliability modes. During the data collection it has become evident that many equipment failures can be attributed to testability, particularly when complex integrated circuits are involved. ESA

**N91-32381#** National Space Development Agency, Tokyo (Japan). Reliability Assurance Dept.
**A PLAN OF NASDA's PARTS DATABASE IN THE RELIABILITY INFORMATION SYSTEM** **c82**
Koichi Shinokazi *In* ESA, ESA Electronic Components Conference Mar. 1991 p 567-568 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The National Space Development Agency of Japan (NASDA) is developing a reliability information system. Present and future NASDA reliability analysis software and parts databases for parts development, parts management, reliability design, etc. are described. A computer database including information on the NASDA's Qualified Products List (NASDA QPL) and Standard Parts List (NASDA SPL) is available on NASDA's computer network. NASDA is applying a System Reliability Optimization Program (SYROP) based on the parts database to tradeoff parameters related to system reliability. NASDA plans for comprehensive parts databases of NASDA standard parts specification. Application data sheet, parts reliability information and device summary sheet are outlined. ESA

**N91-32382#** Aerospatiale, Cannes (France).
**PREPARING ELECTRONICS QUALITY FOR THE NEXT CENTURY**

Jean-Christophe Fachon *In* ESA, ESA Electronic Components Conference Mar. 1991 p 571-573 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Total Quality Management (TQM) concepts adapted to the development of quality electronic components are discussed. TQM as applied in the U.S. is contrasted with possible TQM approaches in Europe. The need for the U.S. and Europe to rise to the challenge of Japan's lead in electronic component manufacturing is stressed. Ways in which TQM policies will affect cooperation between the U.S. and Europe are discussed. A TQM approach is predicted to be widespread in Europe four years after it is established in the U.S. ESA

**N91-32383#** Thomson-CSF, Orsay (France).
**EQML: A CHANCE FOR EUROPE c38**
P. Cuny and M. Barre (MATRA Espace, Paris-Velizy, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 575-577 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The European qualification, approval or capability approval system is found to be poorly adapted to Very Large Scale Integration (VLSI) and Application Specific Integrated Circuits (ASICs). EQML, a European qualification system based on the QML system developed by the U.S. Department of Defense, is described. EQML content in terms of qualification and task definition in integrated circuit manufacturing is discussed. The procedure allows qualifications to be carried out by tradeoffs provided that the interfaces are controlled. ESA

**N91-32384#** Texas Instruments France, Villeneuve-Loubet. Quality Dept.
**SPACE MANUFACTURING QUALITY THROUGH STATISTICAL PROCESS CONTROL: AN APPLICATION AT TEXAS INSTRUMENTS FRANCE, A SPACE SEMICONDUCTORS PRODUCTION LINE c38**
Jean-Paul Andrisi and Frederic Artuphel *In* ESA, ESA Electronic Components Conference Mar. 1991 p 579-585 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Ways in which Statistical Process Control (SPC) can ensure continuous quality improvements, minimize the cost of ownership and generate a total quality environment for all manufacturing and quality control employees are outlined. Cpk and ppm defect rate dependency are discussed. A review of specific examples of SPC technique implementation in space semiconductors production shows how continuous quality improvements support specific space market needs. Two major applications are analyzed: (1) the enhancement of internal wire bonding process quality via SPC driven process improvement, and (2) how wafer manufacturing internal process control data can be used as a substitute for MIL STD 883 method 2010 internal visual inspections procedures. ESA

**N91-32385#** Thomson-CSF, Sainte Egreve (France).
**TOTAL QUALITY MANAGEMENT: WHAT ARE THE FACTS BEHIND THE CONCEPTS? c38**
J. Blanchart *In* ESA, ESA Electronic Components Conference Mar. 1991 p 587-588 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The MIL-I-38535 Total Quality Management (TQM) system is discussed. It is concluded to be the most pragmatic TQM system for the manufacturing of military and space Very Large Scale Integration (VLSI). Changes in manufacturers responsibility due to the system are discussed. The effect of the TQM system on quality improvement programs is discussed. A normalized reliability philosophy based on the TQM system is discussed. Shortcomings of the MIL-I-38535 system in certain TQM areas are identified and ways in which manufacturers can get around these shortcomings are described. ESA

**N91-32386#** Thomson-CSF, Orsay (France).
**WHICH POSITION FOR MIL-SPACE INDUSTRY FACING QML CONCEPT**
P. Cuny and M. Barre (MATRA Espace, Paris-Velizy, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 589-594 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Use of the European Quality Management system EQML by part manufacturers, equipment manufacturers and system users is discussed. Evolution of normalized qualification standards enabling better confidence and cost efficiency in new product generation is discussed. Ways of improving development cycles, yields and product performances using the EQML system are outlined. The main phases involved in the qualification concept are identified. ESA

**N91-32387#** Royal Aerospace Establishment, Farnborough (England).
**COST EFFECTIVE ELECTRONIC COMPONENTS FOR SHORT LIFE SPACE MISSIONS**
J. J. Wall, R. Hymers, and V. B. Berry (Spur Electron Ltd., Havant, England ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 595-600 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A study performed to assess the possibility of reducing short life spacecraft costs by significantly reducing the financial impact of the procurement of Electrical, Electronic and Electromechanical (EEE) components, is described. Strategies for cost reduction which do not compromise the probability of mission success are sought. It is concluded that an overall component cost saving in the area of 90 percent is possible through the procurement of parts screened in accordance with a minimum quality method which is previously defined. An analysis of screening data from final production tests, burn in electrical measurements and lot acceptance tests is suggested as the basis of a procurement cost reduction exercise within space programs. ESA

**N91-32388#** ABB Hafo A.B., Jaerfaella (Sweden).
**ABB HAFO'S ESA APPROVED CAPABILITY DOMAIN FOR CMOS/SOS ASICs**
Christer Eriksson *In* ESA, ESA Electronic Components Conference Mar. 1991 p 603-606 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A capability approval concept used for qualification testing of spaceborne electronic equipment is described. The ESA approved capability domain covers manufacturing of digital Rad Hard Complementary Metal Oxide Semiconductors on Silicon On Sapphire (CMOS/SOS) Application Specific Integrated Circuits (ASICs). The capability approval concept allows for significant reduction in the total ASIC project budget, easier qualification testing, better production control and better quality knowledge among everyone involved in the project. ESA

**N91-32389#** GEC-Plessey Semiconductors, Lincoln (England).
**TECHNOLOGY APPROVAL USING CAPABILITY INDICES c38**
W. J. Anderson *In* ESA, ESA Electronic Components Conference Mar. 1991 p 607-610 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Technology approval is offered as an alternative to conventional component approval procedures. Statistical Process Control (SPC) and capability indices are used to demonstrate manufacturing capability. Applied to mandated systematic performance

improvement, the procedure is intended to meet and exceed the requirements of current systems. Successful implementation of this standard should result in the products of a demonstrably higher quality and reduced cost in comparison to existing approval systems. Technology approval may be granted only to a manufacturer who has been granted manufacturers approval in accordance with the requirements of a recognized national system. ESA

**N91-32390*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**EVALUATION OF ADVANCED MICROELECTRONICS FOR INCLUSION IN MIL-STD-975**
W. Richard Scott *In* ESA, ESA Electronic Components Conference Mar. 1991 p 611-614 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders CSCL 09C

The approach taken by NASA and JPL (Jet Propulsion Laboratory) in the development of a MIL-STD-975 section which contains advanced technology such as Large Scale Integration and Very Large Scale Integration (LSI/VLSI) microelectronic devices is described. The parts listed in this section are recommended as satisfactory for NASA flight applications, in the absence of alternate qualified devices, based on satisfactory results of a vendor capability audit, the availability of sufficient characterization and reliability data from the manufacturers and users and negotiated detail procurement specifications. The criteria used in the selection and evaluation of the vendors and candidate parts, the preparation of procurement specifications, and the status of this activity are discussed. ESA

**N91-32391#** Unisys Corp., Lanham, MD.
**A COMPARISON OF THE SPECIFICATIONS FOR STANDARD ELECTRICAL, ELECTRONIC AND ELECTROMECHANICAL (EEE) PARTS USED BY THE NATIONAL AERONAUTICS AND SPACE ADMININSTRATION (NASA) AND THE EUROPEAN SPACE AGENCY (ESA): TOWARDS COMMON SPECIFICATIONS**
Michael John Sampson *In* ESA, ESA Electronic Components Conference Mar. 1991 p 615-620 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Results of a study comparing Electric, Electronic and Electromechanical (EEE) parts used by NASA and ESA are presented. This test is seen as a first step towards the assessment of part equivalency and as a means to identify the principal barriers to common space part specifications. Progress towards internatinal standardization of procurement specifications is encouraged by multinational cooperation in high technology projects and by the need to complete in world markets. ESA and NASA are partners in Space Station Freedom, and more joint ventures can be anticipated for the future. Successful joint ventures require that the parties concerned have confidence in all the component parts involved. Thus, NASA and ESA share a need to establish equivalency in their space level EEE parts. ESA

**N91-32392#** ANT Nachrichtentechnik, Backnang (Germany, F.R.).
**IS THE ESA/SCC SCREENING TECHNIQUE MORE EFFICIENT THAN THE MIL SPECIFICATIONS?**
R. Theis *In* ESA, ESA Electronic Components Conference Mar. 1991 p 621-625 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

European and internatioonal space programs use parts which are screened according to ESA/SCC and MIL specifications. Hence both specification systems compeie with each other. To illustrate the different specification approaches, discrete semiconductor devices and multilayer ceramic capacitors are taken as an example. The screening technique applicable under both specifications are discussed. The differences for discrete semiconductor devices and the notable shortcomings of the ESA/SCC specifications compared with JAN S level are outlined. It is shown that the screening methods and conditions required in ESA/SCC 3001 are not so well tailored to cope with the specific problems concerning multilayer ceramic capacitors as those laid down in MIL-C-123. After considering the difference, improvements which could be made to the ESA/SCC specifications are proposed. In spite of more appropiate screening tests and methods in the MIL system, the promotion of European parts and the support of European autonomy by the ESA/SCC system, as well as the reputed position of the ESA/SCC system in Europe, U.S. and Japan is taken into consideration. ESA

**N91-32393#** ANT Nachrichtentechnik, Backnang (Germany, F.R.).
**SPECIFICATION, PROCUREMENT AND TESTING OF PASSIVATED MICROWAVE SEMICONDUCTOR CHIPS FOR SPACE APPLICATIONS**
Reinhold L. Zahn and Petra K. Schumacher *In* ESA, ESA Electronic Components Conference Mar. 1991 p 627-632 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Employing passivated microwave semiconductor chip devices in space systems is a challenge for both applications engineeering and parts procurement. The use of chip devices results in miniature circuits as well as optimum circuit performance. The signal to noise ratio and power consumption are improved. With the demand for higher frequencies the dimensions become smaller with associated handling difficulties and problems with regard to chip assembly. The status of procurement specifications applicable to microwave semiconductor chip devices is reviewed, using the ESA/PSS-01-608. Key items for useful procurement specifications are highlighted. Results of testing and handling investigations on low noise microwave Field Effect Transistors (MESFET) chips are described. ESA

**N91-32394#** Siemens A.G., Munich (Germany, F.R.).
**PROGRESS IN SUBMICRON TECHNOLOGIES**
K. Merten and J. Winnerl *In* ESA, ESA Electronic Components Conference Mar. 1991 p 635-638 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Every three years a fourfold increase in the number of functions per unit area on chip is experienced. Today logic integrated circuits with more than a million transistors are available. Logic chips in the 64 M generation are expected to provide more than 10 million components on a chip. Severe changes in the design and fabrication of integrated circuits are discussed. The main trends and characteristics in submicron technologies and requirements for new and more efficient design methodologies are discussed. Typical innovations in various fields of applications are considered. ESA

**N91-32395** National Physical Lab., Teddington (England). Div. of Electrical Science.
**THE UNITED KINGDOM WAVEGUIDE POWER STANDARDS ABOVE 40 GHz**
J. P. Ide Nov. 1990 77 p
(NPL-DES-105; ISSN-0143-7305; ETN-91-99866) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 OLW, England

The United Kingdom national standards for waveguide power consist of commercial thermistor mounts whose effective efficiencies are measured at discrete frequencies. The effective efficiencies are determined using microcalorimeters, and an analysis of the uncertainties involved as well as a description of the microcalorimeters is given. The multistate reflectometers which are used to compare the standards and calibrate power meters are also described. ESA

**N91-32396** Physics and Electronics Lab. TNO, The Hague (Netherlands).
**DESIGN AND EVALUATION OF A GaAs MMIC X-BAND ACTIVE RC QUADRATURE POWER DIVIDER Final Report**
J. C. Henkus Mar. 1991 47 p
(Contract A89/K/659)
(FEL-91-A076; TD-91-0985; ETN-91-99999) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

The design and evaluation of a GaAs MMIC (Microwave Monolithic Integrated Circuit) X-band active RC Quadrature Power Divider (QPD) is addressed. This QPD can be used as part of a vector modulator. The chosen QPD topology consists of two active first order RC all pass networks and was converted into an MMIC design. The design is completely symmetrical except for two key resistors. On-wafer S parameter measurements were carried out; a special probe head configuration was composed in order to avoid measurement accuracy degradation associated with the reversal of the active output of the QPD. The measured nominal RF behavior of the chips complies with the simulated behavior to a very high degree. The optical, DC, and RF yield is very large (97, 83, and 74 percent respectively). A modification to Takashi's all pass network was proposed which offers gain/frequency slope control and compensation ability. ESA

**N91-32397#** Los Alamos National Lab., NM.
**DE HAAS VAN ALPHEN EFFECT IN HIGH TEMPERATURE SUPERCONDUCTORS**
F. M. Mueller 1991 17 p Presented at the Conference on Fermiology of High Tc Superconductors, Argonne, IL, 25-27 Mar. 1991
(Contract W-7405-eng-36)
(DE91-016198; LA-UR-91-2422; CONF-9103112-4) Avail: NTIS HC/MF A03

The de Haas van Alphen effect has been investigated using 100 tesla fields and temperatures below 4.2 Kelvin. It is concluded from these measurements that yttrium barium copper oxide (YBCO) exhibits a Fermi surface with at least three separate extremal frequencies for the c-axis parallel to the applied field. Orbital masses, renormalization g's and scattering rates are estimated from an amplitude analysis. DOE

**N91-32398#** Department of the Navy, Washington, DC.
**PLANAR GALLIUM ARSENIDE NPNP MICROWAVE SWITCH Patent Application**
Harvey S. Newman, inventor (to Navy) 27 Jul. 1990 12 p
(AD-D014948; US-Patent-Appl-SN-558540) Avail: NTIS HC/MF A03 CSCL 09/1

A microwave switch is provided for controlling the transmission of microwave energy in a microstrip transmission line structure. The microwave switch comprises an electrically conducting ground plane in contact with one side of an undoped semiconductor material having on its other side a superlattice of gallium arsenide consisting of a periodic sequence of p- and n-doped gallium arsenide layers. P- and n-type regions are formed integral with and electrically connected to the superlattice, and first and second microstrip transmission lines are electrically connected to respective ones of the n- and p-type regions. Author (GRA)

**N91-32399#** Sandia National Labs., Albuquerque, NM.
**LABORATORY TEST RESULTS OF SOLID STATE VIDEO CAMERAS**
P. Terry and D. A. Greenwoll 1991 13 p Presented at the 32nd Institute of Nuclear Materials Management (INMM) Annual Meeting, New Orleans, LA, 28-31 Jul. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016189; SAND-91-1248C; CONF-910774-52) Avail: NTIS HC/MF A03

Sandia National Laboratories has considerable experience with video systems used for alarm assessment. Until recently the camera of choice for lighted security applications was the monochrome vacuum tube video camera. However, with recent advancements in the solid state imager technology, the integration of tube cameras in security systems may soon become obsolete. The sensitivity and resolution of solid state imagers is approaching that of vacuum tube imagers. In addition, solid state cameras have a relatively long lifetime and require little maintenance. Initial equipment costs are similar. Due to the increased performance of solid state imagers, Sandia has established an ongoing program to evaluate these cameras. The evaluations are performed mainly to verify manufacturers' specifications for resolution, sensitivity, and signal to noise ratio, which are the critical camera parameters that should be considered when designing video systems. This report defines these parameters, describes the test procedures, and provides test results. DOE

**N91-32400#** Sandia National Labs., Albuquerque, NM.
**STRESS STATES IN WOUND CAPACITORS**
R. C. Reuter, Jr. 1991 10 p Presented at the 5th European Capacitor and Resistor Technology Symposium (CARTS), Munich (Germany), 30 Sep. - 3 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016402; SAND-91-1402C; CONF-9109235-1) Avail: NTIS HC/MF A02

Analytical methods which have been developed for the prediction of stress states inside wound capacitors as a result of winding are discussed, and numerical results of calculations made for prototypical capacitors are presented. In particular, results are presented for radial stress and wound tension throughout the capacitor roll, illustrating the complex state of stress which exists. Results are also presented which illustrate how the stress states develop during the winding process and how the stress states depend on the stiffness of the mandrel. DOE

**N91-32401#** Lawrence Livermore National Lab., CA.
**DEVELOPMENT AND OPERATION OF A SOLID-STATE SWITCH FOR THYRATRON REPLACEMENT**
B. T. Merritt and G. R. Dreifuerst 14 Jun. 1991 7 p Presented at the 8th IEEE Pulsed Power Conference, San Diego, CA, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE91-016553; UCRL-JC-105355; CONF-910640-36) Avail: NTIS HC/MF A02

A solid-state switch, consisting of 22 reverse conducting thyristors, has been designed to operate at 20 kV hold-off voltage, 1500 A peak, 57 ARMS, 1.0 microsecond pulse-width, and 4500 pps. To date, 70 switches have been fielded, accummulating over 330,000 unit-hours with a demonstrated MTBF of over 6000 hours. The previously used thyratrons have all been replaced since the solid-state switch has proven to be more reliable. In addition, the solid-state switch is more cost effective due to its ability to be repaired. This paper discusses the design, construction, triggering, operation, reliability, and failure modes of this switch. DOE

**N91-32402#** Lawrence Livermore National Lab., CA.
**DESIGN CRITERIA FOR A MAGNETIC SWITCH WHEN USED TO DISCHARGE A PULSE FORMING LINE**
D. M. Barrett 14 Jun. 1991 6 p Presented at the 8th IEEE Pulsed Power Conference, San Diego, CA, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE91-016559; UCRL-JC-105818; CONF-910640-33) Avail: NTIS HC/MF A02

Much has been written concerning the design of magnetic switches in Melville line pulse compression networks. In these networks, magnetic switches are used to discharge one capacitor into another. Pulse compression is achieved by discharging each capacitor at a faster rate than it was charged. The relationship between the circuit parameters of the Melville line and the individual magnetic switches is fairly well understood. However, magnetic switches are sometimes cast in roles which depart from their traditional use in a Melville line network. One such application is that of a magnetic switch being used to discharge a pulse forming line (PFL) into a load. In this paper, the requirements of such an application are discussed. Relationships between the PFL discharge parameters (i.e., pulse energy, risetime, and pulsewidth)

and the magnetic switch parameters are derived. A design example of a magnetic switch for use in a PFL discharge application is presented and the design trade-offs are also discussed. DOE

**N91-32403#** Sandia National Labs., Albuquerque, NM.
**LOW-COST 3 kV, TRIGGERED, STRIPLINE, SURFACE-DISCHARGE SWITCH**
L. M. Earley and G. L. Scott 1991 3 p Presented at the 8th IEEE Pulsed Power Conference, San Diego, CA, 17-19 Jun. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016641; SAND-90-2881C; CONF-910640-39) Avail: NTIS HC/MF A01

A low-cost, triggered, stripline, surface-discharge switch has been developed which is capable of rapidly switching several kA of peak current for greater than one thousand operations. It was constructed using copper-Kapton (polyimide) printed circuit technology. Switches with DC holdoffs up to 5 kV have been operated at peak currents up to 8 kA prior to failure. Two optimized switch designs have resulted from this investigation. The first uses a multilayer design while the second uses a planar design. The trigger mechanism of both switch designs was studied using photomultiplier tubes (PMT) and high speed framing cameras. DOE

**N91-32404#** California Univ., Berkeley. Lawrence Berkeley Lab.
**CURRENT STATUS OF SOLID-STATE LITHIUM BATTERIES EMPLOYING SOLID REDOX POLYMERIZATION CATHODES**
S. J. Visco, M. M. Doeff, and L. C. DeJonghe Mar. 1991 11 p Presented at the 5th International Seminar on Lithium Battery Technology and Applications, Deerfield Beach, FL, 4-8 Mar. 1991
(Contract DE-AC03-76SF-00098)
(DE91-016988; LBL-30696; CONF-910344-2) Avail: NTIS HC/MF A03

The rapidly growing demand for secondary batteries having high specific energy and power has naturally led to increased efforts in lithium battery technology. Still, the increased safety risks associated with high energy density systems has tempered the enthusiasm of proponents of such systems for use in the consumer marketplace. The inherent advantages of all-solid-state batteries in regards to safety and reliability are strong factors in advocating their introduction to the marketplace. However, the low ionic conductivity of solid electrolytes relative to nonaqueous liquid electrolytes implies low power densities for solid state systems operating at ambient temperatures. Recent advances in polymer electrolytes have led to the introduction of solid electrolytes having conductivities in the range of 10(exp -4)/ohm cm at room temperature; this is still two orders of magnitude lower than liquid electrolytes. Although these improved ambient conductivities put solid state batteries in the realm of practical devices, it is clear that solid state batteries using such polymeric separators will be thin film devices. Fortunately, thin film fabrication techniques are well established in the plastics and paper industry, and present the possibility of continuous web-form manufacturing. This style of battery manufacture should make solid polymer batteries very cost-competitive with conventional secondary cells. In addition, the greater geometric flexibility of thin film solid state cells should provide benefits in terms of the end-use form factor in device design. This work discusses the status of solid redox polymerization cathodes. DOE

**N91-32405#** EG and G Energy Measurements, Inc., Goleta, CA.
**PERFORMANCE EVALUATION OF NEW LARGE-AREA AVALANCHE PHOTODIODES FOR SCINTILLATION SPECTROSCOPY**
K. M. James, M. J. Masterson, and R. Farrell 1991 16 p
(Contract DE-AC08-88NV-10617)
(DE91-017400; EGG-10617-2102) Avail: NTIS HC/MF A03

Avalanche photodiodes (APD's) appear promising for certain applications as a solid state replacement for the photomultiplier tube. The increase in leakage current and capacitance noise with device active area has in the past kept the size of commercially available devices to less than 1 mm (exp 2). Recent advances in fabrication technology have, however, resulted in relatively low noise devices of up to 1 inch in diameter. We have recently evaluated the performance as scintillation spectroscopy detectors of two commercial large area avalanche photodiodes. These APD's exhibit exceptional performance: at 662 KeV a 1 inch diameter device coupled to a CsI(Tl) scintillator and operating at room temperature yielded 6.9 pct. resolution and a 1 cm device coupled to CsI(Tl) and cooled to 260 K gave 4.4 pct. resolution, which is believed to be the best resolution ever recorded for a scintillation spectrometer. DOE

**N91-32406#** Sandia National Labs., Albuquerque, NM.
**PROCESSING ISSUES AND TECHNOLOGIES FOR OPTOELECTRONICS-INTEGRATED CIRCUITS AND DEVICES**
G. A. Vawter 1991 7 p Presented at the SPIE Meeting, Boston, MA, 3-6 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE91-017451; SAND-91-0282C; CONF-9109230-2) Avail: NTIS HC/MF A02

The influence of processing on the design of optical devices and optoelectronic integrated circuits is discussed. Process compatibility of devices used as the basis of a complete optoelectronic integrated circuit will be discussed along with some potential optoelectronic integrated circuits employing only phase modulators and couplers. Specific examples of the application of reactive-ion-beam etching in the formation of passive optical waveguide phase modulators, optical interconnects, turning mirrors, and output couplers in GaAs/AlGaAs are given. DOE

**N91-32407#** Los Alamos National Lab., NM.
**RATE EFFECTS OF STANDARD AND HIGH STRIP CURRENT MICROCHANNEL PLATE IMAGE INTENSIFIERS (MCPIIs)**
G. J. Yates, K. Albright, P. Zagarino, and M. C. Thomas (EG and G Energy Measurements, Inc., Goleta, CA.) 1991 8 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contracts W-7405-eng-36; DE-AC08-88NV-10617)
(DE91-016196; LA-UR-91-2431; CONF-9107115-17; EGG-10617-2107) Avail: NTIS HC/MF A02

The gains of gated microchannel plate image intensifiers (MCPIIs) at high repetition rates (up to 10 kHz) were measured. Comparisons were made between the gain behavior of a standard ITT type F4111 MCPII and similar device incorporating a high strip current microchannel plate. The most notable effect observed for the standard MCPII is a decline in luminous gain with increasing gate repetition rate and with higher input irradiances. The intensifier with the higher strip current microchannel plate (MCP), on the other hand, exhibited little or no reduction in gain for gating frequencies up to 10 kHz under similar test conditions (60 pJ/sq cm input energy density). The charge storage capacity and recharge time of the standard MCPII are most likely the limiting factors in its ability to maintain a constant gain at high repetition rates. The limiting effect of the recharge time on the MCP gain is calculated and compared to the actual measurements. DOE

**N91-32408#** Pacific Northwest Lab., Richland, WA.
**BENEFIT/COST COMPARISON FOR UTILITY SMES APPLICATIONS**
J. G. DeSteese and J. E. Dagle Aug. 1991 6 p Presented at the 26th Intersociety Energy Conversion Engineering (IECE) Conference, Boston, MA, 3-9 Aug. 1991
(Contract DE-AC06-76RL-01830)
(DE91-017425; PNL-SA-19616; CONF-910801-19) Avail: NTIS HC/MF A02

This paper summarizes eight case studies that account for the benefits and costs of superconducting magnetic energy storage (SMES) in system-specific utility applications. Four of these scenarios are hypothetical SMES applications in the Pacific Northwest, where relatively low energy costs impose a stringent test on the viability of the concept. The other four scenarios address SMES applications on high-voltage, direct-current (HVDC) transmission lines. While estimated SMES benefits are based on a previously reported methodology, this paper presents results of

an improved cost-estimating approach that includes an assumed reduction in the cost of the power conditioning system (PCS) from approximately $160/kW to $80/kW. The revised approach results in all the SMES scenarios showing higher benefit/cost ratios than those reported earlier. However, in all but two cases, the value of any single benefit is still less than the unit's levelized cost. This suggests, as a general principle, that the total value of multiple benefits should always be considered if SMES is to appear cost effective in many utility applications. These results should offer utilities further encouragement to conduct more detailed analyses of SMES benefits in scenarios that apply to individual systems.
DOE

**N91-32409#** Lawrence Livermore National Lab., CA.
**PERFORMANCE OF A 10 kV, 625 kA, 85 kJ ENERGY DISCHARGE MODULE UTILIZING A SOLID DIELECTRIC SWITCH**
R. A. Richardson, W. R. Cravey, and D. A. Goerz 1991 6 p Presented at the 8th IEEE Pulsed Power Conference, San Diego, CA, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE91-017432; UCRL-JC-105582; CONF-910640-40) Avail: NTIS HC/MF A02

We have designed and tested an 87-kJ energy discharge system consisting of two 720-(mu)F, 11-kV capacitors discharged through parallel coaxial cables into a 250 nH load. Data will be presented on the current and voltage waveforms, with calculated values of the system inductance and resistance. The bank uses a solid dielectric switch punctured by an explosive bridge wire (EBW) to initiate the discharge. With the capacitors charged to 9 kV, a 625-kA peak current is sent through the load with a ringing frequency of 6.8 kHz. The coaxial cables used to transmit the current to the load are 3 m in length. Both RG-217 and YK-198 cable types were tested, which have an inductance of 74 nH/ft and 35 nH/ft respectively. Normal operation requires that each cable carry 52 kA. The cables were tested to 100 kA each by connecting fewer cables to the load, and gradually increasing the charge voltage. The solid dielectric switch was chosen for high reliability. Details of the switch will be describes and data on its performance will be presented.
DOE

**N91-32410*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**NEUTRON, GAMMA RAY AND POST-IRRADIATION THERMAL ANNEALING EFFECTS ON POWER SEMICONDUCTOR SWITCHES**
G. E. Schwarze and A. J. Frasca 1991 15 p Presented at the Conference on Advanced Space Exploration Initiative Technologies, Cleveland, OH, 4-6 Sep. 1991; cosponsored in part by AIAA, NASA, and OAI Previously announced in IAA as A91-52420
(NASA-TM-105248; E-6577; NAS 1.15:105248; AIAA-91-3525)
Avail: NTIS HC/MF A03 CSCL 09A

The effects of neutron and gamma rays on the electrical and switching characteristics of power semiconductor switches must be known and understood by the designer of the power conditioning, control, and transmission subsystem of space nuclear power systems. The SP-100 radiation requirements at 25 m from the nuclear source are a neutron fluence of 10(exp 13) n/sq cm and a gamma dose of 0.5 Mrads. Experimental data showing the effects of neutrons and gamma rays on the performance characteristics of power-type NPN Bipolar Junction Transistors (BJTs), Metal-Oxide-Semiconductor Field Effect Transistors (MOSFETs), and Static Induction Transistors (SITs) are presented. These three types of devices were tested at radiation levels which met or exceeded the SP-100 requirements. For the SP-100 radiation requirements, the BJTs were found to be most sensitive to neutrons, the MOSFETs were most sensitive to gamma rays, and the SITs were only slightly sensitive to neutrons. Post-irradiation thermal anneals at 300 K and up to 425 K were done on these devices and the effectiveness of these anneals are also discussed.
Author

**N91-32411** Virginia Polytechnic Inst. and State Univ., Blacksburg.
**MODELING AND ANALYSIS OF SPACECRAFT BATTERY CHARGER SYSTEMS Ph.D. Thesis**
Seong Joong Kim 1991 254 p
Avail: Univ. Microfilms Order No. DA9123736

Large signal analysis of various spacecraft power systems is performed to predict the bus dynamics in various modes of operation. The large-signal trajectories of the system's operating point are analyzed employing qualitative graphical representation. The analyses are verified through simulation using EASY5 software. Small-signal dynamic characteristics of spacecraft battery charge converter systems are analyzed to facilitate the design of a control loop for optimum performance and stability. Control-loop designs for the charge converters in bus voltage regulation mode, charge current regulation mode, and peak power tracking mode are discussed.
Dissert. Abstr.

**N91-32412*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**COMPARISON OF HIGH TEMPERATURE, HIGH FREQUENCY CORE LOSS AND DYNAMIC B-H LOOPS OF TWO 50 Ni-Fe CRYSTALLINE ALLOYS AND AN IRON-BASED AMORPHOUS ALLOY**
W. R. Wieserman, G. E. Schwarze, and J. M. Niedra (Sverdrup Technology, Inc., Brook Park, OH.) Sep. 1991 9 p Presented at the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, 4-9 Aug. 1991; sponsored by ANS, SAE, ACS, AIAA, ASME, IEEE, and AIChE
(NASA-TM-105205; E-6515; NAS 1.15:105205) Avail: NTIS HC/MF A02 CSCL 09A

The availability of experimental data that characterizes the performance of soft magnetic materials for the combined conditions of high temperature and high frequency is almost nonexistent. An experimental investigation was conducted over the temperature range of 23 to 300 C and frequency range of 1 to 50 kHz to determine the effects of temperature and frequency on the core loss and dynamic B-H loops of three different soft magnetic materials; and oriented grain 50Ni-50Fe alloy, a nonoriented grain 50Ni-Fe alloy, and an iron based amorphous material (Metglas 2605SC). A comparison of these materials shows that the nonoriented grain 50Ni-50Fe alloy tends to have either the lowest or next lowest core loss for all temperatures and frequencies investigated.
Author

**N91-32413#** Lawrence Livermore National Lab., CA.
**RELIABLE, HIGH REPETITION RATE THYRATRON GRID DRIVER USED WITH A MAGNETIC MODULATOR**
J. V. Hill, D. G. Ball, and D. N. Garrett 14 Jun. 1991 5 p Presented at the 8th IEEE Pulsed Power Conference, San Diego, CA, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE91-016558; UCRL-JC-105815; CONF-910640-32) Avail: NTIS HC/MF A01

The Atomic Vapor Laser Isotope Separation (AVLIS) Program at Lawrence Livermore National Laboratory uses a magnetic modulator switched by a high voltage thyratron to drive a gas discharge laser. The thyratron trigger source must provide an extremely reliable, low jitter, high-rep-rate grid pulse. This paper describes a thyratron grid driver which delivers a 1.2 kV, 80 ns rise time grid pulse into a 50 ohm load at up to 4.5 kHz repetition rate and has demonstrated approximately 10,000 hours MTBF. Since the thyratron is used with a magnetic compression circuit having a delay time of 1.4 ms, this grid driver incorporates a jitter compensation circuit to adjust the trigger timing of the thyratron to provide overall modulator/laser jitter of less than +/- 2 ns. The specific grid driver requirements will be discussed followed by a description of the circuit design and theory of operation. Construction comments will be followed by performance data (for a specific thyratron and magnetic compression circuit), including pulse shape, jitter, and lifetime.
DOE

**N91-32414#** Fermi National Accelerator Lab., Batavia, IL.
**AN APPROXIMATE HSPICE MODEL FOR ORBIT LOW NOISE ANALOG BIPOLAR NPN TRANSISTORS**
T. Zimmerman Jul. 1991 4 p
(Contract DE-AC02-76CH-03000)
(DE91-017220; FNAL-TM-1748) Avail: NTIS HC/MF A01

Vertical bipolar NPN transistors can be fabricated cheaply through MOSIS by using the Orbit 2 micron Low Noise Analog CMOS process. The collector is formed from an N-well, the base from a p-base diffusion, and the emitter from an N-diffusion. However, since this is a CMOS process there is no buried layer in the collector. Therefore the collector resistance is quite large. Also, the minimum emitter size is 8 x 8 microns, which is substantially larger than many fast bipolar processes. For certain applications, though, such as common base or emitter follower amplifiers, the performance of this transistor may be quite acceptable. However, no AC SPICE model is published for this device. This paper describes a simple approximate measurement method that was used at Fermilab to formulate an HSPICE model for these transistor. This method requires only a fast pulse generator and a good digitizing oscilloscope with an active FET probe for the AC measurements. Model parameters for two transistors of different size are then given. DOE

**N91-32415#** Lawrence Livermore National Lab., CA.
**WIDEBAND MICROWAVE GENERATION WITH GaAs PHOTOCONDUCTIVE SWITCHES**
R. L. Druce, M. D. Pocha, K. L. Griffin, J. M. Stein, and B. J. J. OBannon (Rockwell International Corp., Anaheim, CA.) 1991 7 p Presented at the 8th IEEE Pulsed Power Conference, San Diego, CA, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE91-017544; UCRL-JC-105661; CONF-910640-41) Avail: NTIS HC/MF A02

We are using solid state photoconductive switches to generate wideband microwave pulses with peak powers to 20 MW. A parallel-plate Blumlein transmission line is used to directly feed an exponential taper antenna to produce single pulses with rise times of 200 ps and pulse durations of 340 ps (FWHM). Voltages up to 21 kV have been generated in a 1 cm tall, 12 cm wide parallel-plate line. With the switches operated in linear mode, we have demonstrated phasing of several switches to generate a coherent wave. Generated and radiated signals agree very well with numerical calculations. Radiation efficiencies approach 30 percent. The Blumlein dielectric can be changed to produce a damped waveform, thereby modifying the bandwidth of the signal. We have generated damped waveforms of up to 3 cycles using this method. The parallel-plate geometry lends itself to coupling to an antenna structure to radiate efficiently. The geometry also lends itself to expanding the generator in height and width. We have stacked two generators to nearly double the output power without degrading the pulse characteristics. Applications of ultrashort microwave pulses require a high repetition rate and long life from the generator. Life times of greater than 10(exp 5) shots have been seen occasionally at low to medium power densities. As the power density of a solid state photoconductive switch is increased, device life decreases. We have the capability to test devices at a repetition rate of 30 Hz and voltages to 25 kV. Preliminary data indicates that repeated pulse biasing (without switching) of large LEC grown devices in a slab geometry with fields as low as 30 kV/cm damages the switch and eventually leads to failure. DOE

**N91-32416#** Columbia Univ., New York, NY. Microelectronics Sciences Labs.
**PHOTOGENERATED CARRIER-INDUCED REACTIONS ON SEMICONDUCTOR SURFACES**
R. M. Osgood, Jr. 1991 16 p
(Contract DE-FG02-90ER-14104)
(DE91-017550; DOE/ER-14104/2) Avail: NTIS HC/MF A03

We report an investigation of fundamental photochemical mechanisms operable on insulating and semiconducting substrates. The experiments were done in two separate ultra-high vacuum (UHV) machines, customized to do photofragmentation analysis, and with excimer laser sources. We have studied ultraviolet induced reactions of halogen-containing molecules with a well-defined GaAs(110) surface under ultra-high vacuum (UHV) conditions. First, illumination of a molecular-chlorine-covered surface at 85 K with 193-, 248-, and 351-nm radiation leads to the desorption of Cl-atoms as well as the formation of AsCl3, which desorbed at 180 K. No new desorption species were observed when the surface was irradiated with a 535-nm laser, indicating that the process is not initiated by near-thermal electron-hole pair formation in the substrate. Based on the high cross section for photofragmentation at 193 nm, the gas-phase and condensed chlorine absorption spectra, and the comparison of Cl atoms time-of-flight distributions on GaAs and transparent substrates such as Al2O3 and quartz, we conclude that the reactions are initiated by charge transfer between adjacent adsorbate molecules. This observation is the first result indicating that intermolecular charge transfer followed by dissociation is an important surface photochemical mechanism at mid-UV wavelengths. In contrast to chlorine, CCl4 reacts with an n-GaAs(110) only in the presence of above bandgap light, resulting in the desorption of GaCl at 650 K. Thus, it provides a clear example of charge transfer from the underlying substrate leading to light-induced surface reactions. Finally, we have investigated UV-induced C-Br bond cleavage in CH3Br adsorbed layers on GaAs(110) and other substrates. This experiment has enabled us to make the first observation of the influence of the standing UV waves on the surface photodissociation process. DOE

**N91-32417#** Lawrence Livermore National Lab., CA.
**HIGH TEMPERATURE SUPERCONDUCTIVITY: THE EARLY 1991 EDITION**
E. Teller Jul. 1991 6 p Presented at the Workshop on Strong, Weak, and Electromagnetic Interactions in Nuclei and Astrophysics, Livermore, CA, 3-4 Jan. 1991
(Contract W-7405-eng-48)
(DE91-017655; UCRL-JC-108076; CONF-9101100-5) Avail: NTIS HC/MF A02

Basic theory on the superconductivity in high temperature superconductors is presented. The structure of La2CuO4 is studied with emphasis on the perovskite layers. Topics of interest include electron holes, brillouin zones, and bipolarons. Also, values of the superconducting transition temperature are discussed. DOE

**N91-32418#** Oak Ridge National Lab., TN.
**NEUTRON DIFFRACTION BY THE FLUX LATTICE IN HIGH-Tc SUPERCONDUCTORS**
R. Cubitt, E. M. Forgan, S. L. Lee, J. S. Abell, D. M. Paul (Warwick Univ., Coventry, England ), H. A. Mook, and P. Timmins 1991 6 p Presented at the International Conference on Neutron Scattering in Conjunction With the International Conference on Magnetism, Oxford, England, 27-30 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017866; CONF-9108108-1) Avail: NTIS HC/MF A02

We discuss information about the degree of perfection of flux lattices in superconductors in the mixed state that may be obtained from our small-angle neutron diffraction data. DOE

**N91-32419#** Oak Ridge National Lab., TN.
**NEUTRON SCATTERING FROM THE FLUX LATTICE IN HIGH TEMPERATURE SUPERCONDUCTORS**
D. McK. Paul, E. M. Forgan, R. Cubitt, S. L. Lee (Birmingham Univ., England ), H. A. Mook, and P. Timmins 1991 11 p Presented at the International Conference on Magnetism, Edinburgh, Scotland, 1-7 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017947; CONF-910903-10) Avail: NTIS HC/MF A03

Neutron scattering has been used to observe diffraction from the flux-line lattice in high temperature superconductors. This technique is particularly useful in such systems as it allows observations to be made over a wide range of temperature and magnetic field. Experiments on the systems K(0.4)Ba(0.6)BiO3 and

YBa2Cu3O(7 to 8) will be described with applied magnetic fields of up to 4 Tesla and for temperatures from 2K to (Tc). DOE

**N91-32420#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.
**CAPABILITY APPROVAL PROGRAMME FOR MICROWAVE HYBRID INTEGRATED CIRCUITS (MHICS)**
Nov. 1990 79 p
(ESA-PSS-01-612-Issue-1; ISSN-0379-4059; ETN-91-90068)
Copyright Avail: NTIS HC/MF A05

The general requirements for capability approval of a manufacturing line for Microwave Hybrid Integrated Circuits (MHICs) are defined. ESA approval mandate will be exercized upon conclusion of the evaluation phase and at the end of the program. Before the evaluation phase can commence, the manufacturer must define the capability approval domain by specifying the processes, materials and technology for which approval is sought. ESA

**N91-32421#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Materials and Processes Div.
**THE CRIMPING OF HIGH-RELIABILITY ELECTRICAL CONNECTIONS**
Dec. 1990 34 p
(ESA-PSS-01-726-Issue-2; ISSN-0379-4059; ETN-91-90069)
Copyright Avail: NTIS HC/MF A03

ESA requirements and quality assurance provisions for crimping wire terminations intended for high reliability electrical connections are defined. These terminations include removable contacts, coaxial connectors and ferrules which are crimped to wire conductors and other electrical or electronic components for use on ESA spacecraft and associated equipment operating under high vacuum, thermal cycling and vibration. ESA

**N91-32422#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Materials and Processes Div.
**THE REPAIR AND MODIFICATION OF PRINTED-CIRCUIT BOARD ASSEMBLIES FOR SPACE USE**
Mar. 1991 89 p
(ESA-PSS-01-728-Issue-2; ISSN-0379-4059; ETN-91-90070)
Copyright Avail: NTIS HC/MF A05

The repair and modification procedures designed to maintain the rigorous standards set by ESA for the manufacture and assembly of space quality printed circuit boards, are detailed. The following are considered: preparatory conditions; removal of conformal coating, solder joint removal and unclinching; repair of damaged gold plated areas, conductor tracks, lifted conductors, lifted terminal area (pods); terminal post replacement; wire to wire points; addition of components; removal and replacement of axial and multilead components; removal and replacement of flat pack components; modification of component connections; cutting of internal track of a multilayer printed circuit board; quality assurance. ESA

**N91-32255*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**PERFORMANCE OF A HIGH T(SUB c) SUPERCONDUCTING ULTRA-LOW LOSS MICROWAVE STRIPLINE FILTER**
J. J. Bautista, Gerardo G. Ortiz, C. Zahopoulos, S. Sridhar, and M. Lanagan (Argonne National Lab., IL.) *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 60-65 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

**N91-32256*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**EQUIVALENT CIRCUIT MODEL OF TRAVELING-WAVE MASER SLOW-WAVE STRUCTURES**
J. Shell *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 66-92 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

**N91-32258*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**DESIGN AND TESTING OF AN ACTIVE QUENCHING CIRCUIT FOR AN AVALANCHE PHOTODIODE PHOTON DETECTOR**
D. Arbel and J. A. Schwartz *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 102-110 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

**N91-32261*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SYMBOL LOCK DETECTION IN THE ARX 2 AND BLOCK 5 RECEIVERS**
M. Shihabi, S. Hinedi, and B. Shah *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 132-154 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

**N91-32262*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**DESIGN AND STATUS OF THE RF-DIGITIZER INTEGRATED CIRCUIT**
B. Rayhrer, B. Lam, L. E. Young, J. M. Srinivasan, and J. B. Thomas *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 155-159 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

**N91-32265*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**TESTING INTERCONNECTED VLSI CIRCUITS IN THE BIG VITERBI DECODER**
I. M. Onyszchuk *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 175-182 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09C

**N91-32272*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**DSS 13 PHASE 2 PEDESTAL ROOM MICROWAVE LAYOUT**
T. Cwik and J. C. Chen *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 298-306 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 09A

**N91-32624*#** General Semiconductor Industries, Inc., Tempe, AZ.
**HARDENING COMMUNICATION PORTS FOR SURVIVAL IN ELECTRICAL OVERSTRESS ENVIRONMENTS**
O. Melville Clark *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 8 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

**N91-32629*#** Florida Univ., Gainesville. Dept. of Electrical Engineering.
**CHARACTERIZATION OF VERTICAL ELECTRIC FIELDS AND ASSOCIATED VOLTAGES INDUCED ON A OVERHEAD POWER LINE FROM CLOSE ARTIFICIALLY INITIATED LIGHTNING**
Marcos Rubinstein, Martin A. Uman, Ewen M. Thomson, and Pedro J. Medelius *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced as N91-26656 (For primary document see N91-32599 24-47)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A99 CSCL 09C

**N91-32635*#** Federal Aviation Administration, Atlanta, GA.
**DESIGNS FOR SURGE IMMUNITY IN CRITICAL ELECTRONIC FACILITIES**
Edward F. Roberts, Jr. *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 7 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

**N91-32638*#** United Kingdom Atomic Energy Authority, Abingdon (England).
**THE ELECTROMAGNETIC ENVIRONMENT IN CFC STRUCTURES**
C. J. Hardwick and S. J. Haigh *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Sponsored in part by the Culham Lightning Club; British Aerospace, Rolls Royce, Westlands, CASA, SAAB, Shorts, CAA and DTI (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

**N91-32639*#** United Kingdom Atomic Energy Authority, Abingdon (England).
**A NEW APPROACH TO EQUIPMENT TESTING**
C. J. Hardwick, V. P. Dunkley, B. J. C. Burrows, and I. Darney *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Sponsored in part by Culham Lightning Club, British Aerospace, Rolls Royce, Westlands, CASA, SAAB, Shorts, CAA and DTI (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

**N91-32643*#** Raychem Ltd., Swindon (England).
**LIGHTNING PROTECTION OF FULL AUTHORITY DIGITAL ELECTRONIC SYSTEMS**
David Crofts *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

**N91-32694*#** Electrical Research Association, Leatherhead (England).
**LIGHTNING INDUCED CURRENTS IN AIRCRAFT WIRING USING LOW LEVEL INJECTION TECHNIQUES**
E. G. Stevens and D. T. Jordan (Royal Aircraft Establishment, Farnborough, England ) *In* NASA, Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09C

**N91-32716*#** United Kingdom Atomic Energy Authority, Culham (England). Lightning Test and Technology.
**THE NEW SECTION 23 OF DO160C/ED14C LIGHTNING TESTING OF EXTERNALLY MOUNTED ELECTRICAL EQUIPMENT**
B. J. C. Burrows *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

**N91-32719*#** Voeikov Main Geophysical Observatory, Leningrad (USSR).
**ON ERROR SOURCES DURING AIRBORNE MEASUREMENTS OF THE AMBIENT ELECTRIC FIELD**
B. F. Evteev *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 11 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

**N91-32722*#** Monroe Electronics, Inc., Lyndonville, NY.
**LT-23: THE FEEDBACK VIBRATING CAPACITOR FIELDMETER**
James R. Vosteen and William E. Vosteen *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 13 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

**N91-32727*#** Universidad Nacional de Cordoba (Argentina). Facultad de Matematica Astronomia y Fisica.
**CHARGE TRANSFER DURING INDIVIDUAL COLLISIONS IN ICE GROWING BY RIMING**
Eldo E. Avila and Giorgio M. Caranti *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 15 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09C

**N91-32730*#** Harris Corp., Palm Bay, FL. Electronic Systems Div.
**DIFFUSE DISPERSIVE DELAY AND THE TIME CONVOLUTION/ATTENUATION OF TRANSIENTS**
Burt J. Bittner *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 5 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

**N91-32734*#** Florida Univ., Gainesville. Dept. of Electrical Engineering.
**VOLTAGES INDUCED ON A POWER DISTRIBUTION LINE BY OVERHEAD CLOUD LIGHTNING**
Ziad Yacoub, Marcos Rubinstein, Martin A. Uman, Ewen M. Thomson, and Pedro J. Medelius *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09C

**N91-32737*#** Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH. Pulse Power Group.
**HIGH CURRENT PULSE TESTING FOR GROUND ROD INTEGRITY**
Lawrence C. Walko *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

# 34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

**N91-32423** Virginia Polytechnic Inst. and State Univ., Blacksburg.
**THE DEVELOPMENT OF SOLUTION ALGORITHMS FOR COMPRESSIBLE FLOWS Ph.D. Thesis**
David Christopher Slack 1991 163 p
Avail: Univ. Microfilms Order No. DA9120403

Three main topics were examined. The first is the development and comparison of time integration schemes on 2-D unstructured meshes. Both explicit and implicit solution grids are presented. Cell centered and cell vertex finite volume upwind schemes using Roe's approximate Riemann solver are developed. The second topic involves an interactive adaptive remeshing algorithm which uses a frontal grid generator and is compared to a single grid

calculation. The final topic examined is the capabilities developed for a structured 3-D code called GASP. The capabilities include: generalized chemistry and thermodynamic modeling, space marching, memory management through the use of binary C I/O, and algebraic and two equation eddy viscosity turbulence modeling. Results are given for Mach 1.7 3-D analytic forebody, a Mach 1.38 axisymmetric nozzle with hydrogen-air combustion, a Mach 14.15 deg ramp, and Mach 0.3 viscous flow over a flat plate.
Dissert. Abstr.

**N91-32424#** Admiralty Research Establishment, Gosport (England).
**COMPONENT LOCAL VELOCITIES OF A SHIP ALONG A DEFINED AXIS**
P. Crossland and A. R. J. M. Lloyd Feb. 1991 17 p Original contains color illustrations
(ARE-TM(UHR)-91305; BR300555; ETN-91-99861) Copyright Avail: NTIS HC/MF A03

A method of calculating the component local velocities along a given axis when a ship is traveling at forward speed in long crested waves, is outlined. The results presented appear reasonable and illustrate expected trends. Only root mean square velocities along an axis are considered and not motions perpendicular to the defined axis. The theory and its subsequent inclusion into PAT-91 (ship motion computer program) are recorded in this technical memorandum. ESA

**N91-32425#** Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
**RECIPROCITY THEORY OF BINARY INELASTIC ENCOUNTERS**
Adolf A. Agbormbai Aug. 1989 45 p
(IC-Aero-89-03; ISSN-0308-7247; ETN-91-99879) Avail: NTIS HC/MF A03

Since the Direct Simulation Monte Carlo (DSMC) method has established itself as a standard technique for numerically computing rarefied gas flows it follows that to develop the theory of rarefied gas dynamics a framework for its fundamental microscopic processes needs to be formulated, i.e., intermolecular collisions and gas surface interactions, which lead to rigorous statistical models that can be utilized in the code. In this report, attention is focussed on the binary inelastic encounter for which a statistical theory is exposed based on the principle of reciprocity at equilibrium. ESA

**N91-32426#** Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
**COMPUTATIONAL FLUID DYNAMICS**
1991 653 p Lecture series held in Rhode-Saint-Genese, Belgium, 18-22 Feb. 1991
(VKI-LS-1991-01; ISSN-0377-8312; ETN-91-99902) Copyright Avail: NTIS HC/MF A99

The well-posedness of initial boundary value problems for the Euler and Navier-Stokes equations, and the related stability theory for finite difference approximations are discussed. A general analysis of scalar advection schemes on compact stencils was presented. Methods for compressible flow simulation were examined. Multidimensional wave models and a new flux balance splitter satisfying a two dimensional property were presented. As far as incompressible flows were concerned, spectral element discretization and stabilized finite element discretization were investigated. Two different applications for parabolized Navier-Stokes approach were discussed, each having its own specific treatment of the pressure terms in the momentum equation. For individual titles, see N91-32427 through N91-32434.

**N91-32427#** Uppsala Univ. (Sweden).
**THE EULER AND NAVIER-STOKES EQUATIONS. WELLPOSEDNESS, STABILITY AND COMPOSITE GRIDS**
Bertil Gustafsson *In* VKI, Computational Fluid Dynamics 1991 57 p (For primary document see N91-32426 24-34)
Copyright Avail: NTIS HC/MF A99

The wellposedness of the Euler and Navier-Stokes equations, and the stability of difference approximations were discussed. Emphasis was put on the method of analysis. The stability theory was presented as an example, in order to illustrate the basic principles. Recent results concerning solution methods on composite grids were presented. ESA

**N91-32428#** Vrije Univ., Brussels (Belgium). Dept. of Fluid Mechanics
**A GENERAL ANALYSIS OF TWO-DIMENSIONAL CONVECTION SCHEMES**
C. Hirsch *In* VKI, Computational Fluid Dynamics 1991 27 p (For primary document see N91-32426 24-34)
Copyright Avail: NTIS HC/MF A99

A general analysis of two dimensional upwind convection schemes for the linear, nonhomogeneous convection equation, based on compact molecules, not exceeding nine points is presented. The analysis relies on the properties of the truncation error expansion, taking a computational stencil with arbitrary coefficients as a starting point. For a finite volume formulation of the schemes in the framework of a cell centered approach, some of the coefficients are specified, in order to satisfy the consistency conditions. The general discussion is restricted to six points and four points molecules in the upwind direction. General conditions can be defined for properties such as second order accuracy, zero cross diffusion, monotonicity of the schemes, and relations between some of these conditions. ESA

**N91-32429#** Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
**UPWIND METHODS AND MULTIDIMENSIONAL SPLITTINGS FOR THE EULER EQUATIONS**
Herman Deconinck *In its* Computational Fluid Dynamics 1991 49 p (For primary document see N91-32426 24-34)
Copyright Avail: NTIS HC/MF A99

Upwind space discretization methods for the multidimensional Euler equations are presented. It is shown that in a one dimensional space, space gradients for the flow variables can be decomposed into two parts corresponding to the propagation direction. The mechanism behind the decomposition is discussed. It is shown how to use the decomposition to construct first order upwind differencing schemes. The extension to second order accuracy is examined. The interpretation of some of these upwind differencing schemes as approximate Riemann solvers is discussed, after introducing the Godunov scheme. The use of upwinding principles for the Euler equation in two space dimensions is studied. Two alternative purely flow dependent decompositions are investigated and compared with each other. ESA

**N91-32430#** Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
**FLUCTUATION SPLITTING SCHEMES FOR THE 2D EULER EQUATIONS**
R. Struijs, Herman Deconinck, and P. L. Roe (Michigan Univ., Ann Arbor.) *In its* Computational Fluid Dynamics 1991 94 p (For primary document see N91-32426 24-34)
(Contract AERO-0003-C)
Copyright Avail: NTIS HC/MF A99

Analytical and numerical results for a relatively new space discretization method and wave decomposition method are presented. Linear advection schemes in one dimension are explained. The theory for two dimensional linear advection, defining and demonstrating positive and linearity preserving schemes' is examined. A generalization of Godunov's theorem is presented, showing incompatibility between linearity preservation and positivity for linear schemes. Nonlinear schemes are reported. Extension of the schemes to nonlinear scalar conservation law is given. It is shown how the fluctuation splitting space discretization method can be combined with the Euler equations in decomposed form.
ESA

**N91-32431#** Minnesota Univ., Minneapolis. Supercomputer Inst.
**STABILIZED FINITE ELEMENT FORMULATIONS FOR INCOMPRESSIBLE FLOW COMPUTATIONS Abstract Only**
Tayfan E. Tezduyar *In* VKI, Computational Fluid Dynamics 1991 2 p (For primary document see N91-32426 24-34)
(UMSI-91/66) Copyright Avail: NTIS HC/MF A99

It is shown that stabilization techniques prevent the numerical oscillations that might be generated by the presence of dominant advection terms or by appropriate combination on interpolation functions used for velocity and pressure. The stabilization techniques emphasized are the Galerkin/least squares, streamline upwind/Petrov Galerkin, and pressure stabilizing/Petrov Galerkin formulations. Some of these techniques are based on finite element discretization in both space and time. Most of the numerical examples considered are unsteady flow problems, including those involving moving boundaries and interfaces. ESA

**N91-32432#** Nektonics, Inc., Cambridge, MA.
**SPECTRAL ELEMENT METHODS FOR THE UNSTEADY NAVIER-STOKES EQUATIONS**
Einar Malvin Roenquist *In* VKI, Computational Fluid Dynamics 1991 177 p (For primary document see N91-32426 24-34)
Copyright Avail: NTIS HC/MF A99

A Legendre spectral element spatial discretization is presented for the unsteady Navier-Stokes equations based on consistent approximation spaces for velocity and pressure and a nondissipative convection operator. The resulting discrete equations are solved by a semi implicit method in time, with the linear Stokes operator being treated implictly and the nonlinear convection operator treated explicitly. The fully discrete equations are solved iteratively. Numerical results are presented, in order to demonstrate the accuracy, efficiency and generality of the approach for the solution of incompressible flow problems. ESA

**N91-32433*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**PARABOLIZED NAVIER-STOKES METHODS FOR HYPERSONIC FLOWS**
Scott L. Lawrence *In* VKI, Computational Fluid Dynamics 1991 107 p (For primary document see N91-32426 24-34)
Copyright Avail: NTIS HC/MF A99

A representative sampling of the techniques used in the integration of the Parabolized Navier-Stokes (PNS) equations is presented. Special atention is given to recent algorithms developed specifically for application to high speed flows, characterized by the presence of strong embedded shock waves and real gas effects. It is shown that PNS solvers are being used in the analysis of sonic boom signatures. Methods for modeling physical effects are discussed, including an overview of commonly used turbulence models and a more detailed discussion of techniques for including equilibrium and finite rate real gas effects. ESA

**N91-32434#** Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
**PARABOLIZED NAVIER-STOKES METHODS FOR DUCTED FLOW SYSTEMS**
R. Aslan *In its* Computational Fluid Dynamics 1991 116 p (For primary document see N91-32426 24-34)
(Contract BMVg-T/RF42/G022/G1412)
Copyright Avail: NTIS HC/MF A99

The methods described are for steady subsonic internal flows. The governing equations and the method of solution applied in these methods are described. A Parabolized Navier-Stokes (PNS) solution procedure based on Briley's method is explained in detail. It is shown that this procedure is used for the predictions of the flow field in ducts of arbitrary shapes from laminar to turbulent flow, considering incompressible and compressible behavior of air. Example results obtained for a variety of duct configurations and low conditions are presented. ESA

**N91-32435#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
**SOLUTION OF PERFECT GAS VISCOUS FLOWS VIA COMPRESSIBLE NAVIER-STOKES EQUATIONS WITH WALLSLIP CONDITIONS Final Summary Report [CALCUL D'ECOULEMENTS VISQUEUX DE GAZ PARFAIT PAR RESOLUTION DES EQUATIONS DE NAVIER-STOKES COMPRESSIBLES AVEC CONDITIONS DE GLISSEMENT A LA PAROI]**
G. Rollin and H. Hollanders May 1990 56 p In ENGLISH and FRENCH
(Contract DRET-89-34-001)
(ONERA-RSF-13/3637-AY; ETN-91-90028) Avail: NTIS HC/MF A04

Rare gas wall behavior is considered. Plane sheet flow at Mach number 20 to infinity is studied for Reynolds numbers of 2850 and 8380, angles of attack of 0 and 10 degrees, and for chamfered edge and truncated sheets. For each configuration both a classical approach calculation adhering to the wall of the sheet and a rarefied gas calculation with slip condition was performed. Sixteen calculations were executed in all. The comparison between the experiments and the calculations depend on the distribution of mass volume. A paper entitled Navier-Stokes high speed flow calculations by an implicit noncentered method is annexed. For individual title, see N91-32436.

**N91-32436#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**NAVIER-STOKES FLOW CALCULATIONS BY AN IMPLICIT NON-CENTERED METHOD**
H. Hollanders and C. Marmignon *In its* Solution of Perfect Gas Viscous Flows Via Compressible Navier-Stokes Equations with Wallslip Conditions May 1990 p 16-58 Presented at 27th AIAA Aerospace Sciences Meeting, Reno, NV, 8-12 Jan. 1989 (For primary document see N91-32435 24-34)
Avail: NTIS HC/MF A04

An implicit time upweighted finite volume method for solving the two dimensional and three dimensional time dependent Navier-Stokes equations is presented and applied to various configurations of hypersonic laminar flows, in the assumption of perfect gas. The inviscid fluxes are evaluated by means of a noncentered second order total variation diminishing scheme; the viscous ones being treated by a centered scheme. Results are first presented for two dimensional planar flows over ramps at free stream Mach number 14.1, Reynolds number 104,000, and various wedge angles. Calculations are also performed for two dimensional axisymmetric and three dimensional flows over 15 degree sphere cone at Mach number 10.6, Reynolds number 100,000, and angles of attack of 0 and 15 degrees, and for two dimensional axisymmetric near wake flow behind a 10 degrees sphere cone at a Mach number of 12.8 and a Reynolds number of 250,000. Comparisons of results with experimental data show a good general agreement for both two and three dimensional calculations. ESA

**N91-32437#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
**NUMERICAL STUDY OF PARTITIONED TURBULENCE Final Summary Report [ETUDE NUMERIQUE DE LA TURBULENCE EN PRESENCE DE PAROIS]**
G. Veber and K. DangTran Oct. 1990 37 p In ENGLISH and FRENCH
(Contract DRET-89-34-001)
(ONERA-RSF-20/3419-AY-124A; ETN-91-90029) Avail: NTIS HC/MF A03

The numerical study of turbulence under partitioning is addressed. A subgrid model of homogeneous shear flow, for simulating the large structures of level channel turbulent flows, is studied. The extension of the direct simulation technique, developed for internal turbulent flows evolving in time level, of the level channel type, at more complicated configurations, is considered. The extension of this same technique at internal turbulent flows evolving

in space (with inlet/outlet boundary conditions), i.e., the flow in a diverging channel, is considered. For individual title, see N91-32438.

**N91-32438#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Aerodynamics Dept.
**SPECTRAL TRANSFER ANALYSIS FOR SUBGRID-SCALE MODELLING**
K. Dang and C. Tesseidre *In its* Numerical Study of Partitioned Turbulence Oct. 1990 p 35-38 Presented at 7th Symposium on Turbulent Shear Flows, Stanford, CA, 21-23 Aug. 1989 Previously announced in IAA as A90-11143 (For primary document see N91-32437 24-34)
Avail: NTIS HC/MF A03

Energy exchange mechanisms between resolved and unresolved scales in large eddy simulations of homogeneous turbulence are analyzed by computing transfer spectra from results of direct simulation for isotropic and sheared turbulence. Properties of several subgrid scale models are shown by comparing true and modelized transfer functions and improvements are proposed for eddy viscosity models. ESA

**N91-32439#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. fuer Physik der Atmosphaere.
**NUMERICAL SIMULATION OF TURBULENT CONVECTION OVER WAVY SURFACES Ph.D. Thesis - Technische Univ.**
Kilian Krettenauer Mar. 1991 175 p In GERMAN; ENGLISH summary Report will also be announced as translation ESA-TT-1268
(DLR-FB-91-12; ISSN-0939-2963; ETN-91-90043; ESA-TT-1268)
Avail: NTIS HC/MF A08; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 53 DM

Thermal convection of a Boussinesq fluid layer, confined between two infinite horizontal walls, is investigated by direct numerical and large eddy simulations. A constant heat flux is prescribed at the lower boundary which varies sinusoidally in one direction. At the plane top, an adiabatic frictionless boundary condition was applied which is considered to be a fair approximation of the capping inversion of an atmospheric convective boundary layer. Main interest is focused on turbulence statistics and characteristic large scale structures. The mean features of the flow are found to be rather insensitive with respect to variations of wave length, amplitude, domain size, and even simulation type. However, some influence is detected in the flow's details. ESA

**N91-32440*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**A LASER VELOCIMETER INVESTIGATION OF THE NORMAL SHOCK-WAVE BOUNDARY LAYER INTERACTION Ph.D. Thesis, Toledo Univ.**
Randall M. Chriss Sep. 1991 123 p
(NASA-TM-105201; E-6504; NAS 1.15:105201) Avail: NTIS HC/MF A06 CSCL 20D

Nonintrusive 3-D measurements were made of a normal shock wave/turbulent boundary layer interaction. The measurements were made through a quadrant of a square test section of a continuous flow supersonic wind tunnel in which a normal shock wave had been stabilized. Two dimensional measurements were made throughout the interaction region while 3-D measurements were made near the corner in the vicinity of the shock where 3-D flow effects were expected to be significant. Laser Doppler velocimetry, surface static pressure measurements, and flow visualization techniques were used for two freestream nominal Mach number test cases: 1.6 and 1.3. No turbulence information was obtained. The mean velocity measurements were converted to Mach number by recording the wind tunnel total temperature. Some shock oscillation was present during both of the test cases. After startup of the wind tunnel, the shock oscillated with an amplitude of approx. + or - 1 cm, however, after reaching steady condition, the shock oscillation amplitude was greatly reduced, as evidenced by the laser velocimeter results. The Mach 1.3 test case resulted in a nearly uniform flow without secondary shock waves and with no or very isolated corner separation. Author

**N91-32441*#** North Carolina State Univ., Raleigh.
**AN APPROXIMATE VISCOUS SHOCK LAYER TECHNIQUE FOR CALCULATING CHEMICALLY REACTING HYPERSONIC FLOWS ABOUT BLUNT-NOSED BODIES**
F. McNeil Cheatwood and Fred R. DeJarnette Aug. 1991 195 p
(Contract NCC1-100)
(NASA-CR-187617; NAS 1.26:187617) Avail: NTIS HC/MF A09 CSCL 20D

An approximate axisymmetric method was developed which can reliably calculate fully viscous hypersonic flows over blunt nosed bodies. By substituting Maslen's second order pressure expression for the normal momentum equation, a simplified form of the viscous shock layer (VSL) equations is obtained. This approach can solve both the subsonic and supersonic regions of the shock layer without a starting solution for the shock shape. The approach is applicable to perfect gas, equilibrium, and nonequilibrium flowfields. Since the method is fully viscous, the problems associated with a boundary layer solution with an inviscid layer solution are avoided. This procedure is significantly faster than the parabolized Navier-Stokes (PNS) or VSL solvers and would be useful in a preliminary design environment. Problems associated with a previously developed approximate VSL technique are addressed before extending the method to nonequilibrium calculations. Perfect gas (laminar and turbulent), equilibrium, and nonequilibrium solutions were generated for airflows over several analytic body shapes. Surface heat transfer, skin friction, and pressure predictions are comparable to VSL results. In addition, computed heating rates are in good agreement with experimental data. The present technique generates its own shock shape as part of its solution, and therefore could be used to provide more accurate initial shock shapes for higher order procedures which require starting solutions. Author

**N91-32442*#** Duke Univ., Durham, NC. Dept. of Mechanical Engineering and Materials Science.
**CALCULATION OF UNSTEADY LINEARIZED EULER FLOWS IN CASCADES USING HARMONICALLY DEFORMING GRIDS**
Kenneth C. Hall and William S. Clark 1991 18 p
(Grant NAG3-1192)
(NASA-CR-188916; NAS 1.26:188916) Avail: NTIS HC/MF A03 CSCL 20D

A method for calculating unsteady, inviscid, compressible flows in cascades is presented. Using the linearized Euler technique, the flow is decomposed into a steady or mean flow plus a harmonically varying small disturbance flow. The equations that describe the small disturbance flow are linear variable coefficient equations, and are solved using a pseudo-time time marching Lax-Wendroff technique. Unlike previous linearized methods, however, the solution is computed on a harmonically deforming computational grid that conforms to the motion of the vibrating airfoils. The mean flow and perturbation flow solutions are defined in the deforming coordinate system rather than in a coordinate system fixed in space. Hence, no extrapolation terms are required to implement the upwash boundary conditions at the airfoil surfaces, significantly improving the accuracy of the method. For transonic flow calculations, unsteady shock motions are modelled using shock capturing. The unsteady loads due to the shock motion are then seen as pressure impulses. Representative computational results are presented for transonic channel flows and subsonic and transonic cascade flows. Author

**N91-32443#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
**APPRAISAL OF THE SUITABILITY OF TURBULENCE MODELS IN FLOW CALCULATIONS**
Jul. 1991 100 p Review held in Friedrichshafen, Fed. Republic of Germany, 26 Apr. 1990

(AGARD-AR-291; ISBN-92-835-0625-1) Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A status review is presented of the activities in several NATO nations which is aimed at assessing the use and suitability of existing, and emerging, turbulence models in flow field calculations. Assessments are presented for both steady and unsteady flow fields associated with a variety of problems. These problems included forced convection flow fields for both attached and separated shear layers, two phase flow, and turbulent reacting flows in addition to flow fields driven by free convection. These assessments indicate that there is presently no universal turbulence model which provides acceptable results for a broad spectrum of flow problems and some doubt is expressed concerning the possibility of ever being able to develop such a model. However, some success is noted for turbulence models which were developed for and applied to problems with similar flow field characteristics. For individual titles, see N91-32444 through N91-32451.

**N91-32444#** National Aerospace Lab., Amsterdam (Netherlands).

**TURBULENCE MODELLING: SURVEY OF ACTIVITIES IN BELGIUM AND THE NETHERLANDS, AN APPRAISAL OF THE STATUS AND A VIEW ON THE PROSPECTS**

B. vandenBerg *In* AGARD, Appraisal of the Suitability of Turbulence Models in Flow Calculations Jul. 1991 7 p (For primary document see N91-32443 24-34)

Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Turbulence research proceeding presently at various places in the Netherlands and Belgium is briefly reviewed. Subsequently some experimental results obtained in turbulent boundary layers, as occur on airplane wings, are considered in relation to the usual turbulence model assumptions. The status of turbulence modelling is found not to be satisfactory. To support the development of semiempirical models of acceptable accuracy, a more extensive base of reliable turbulence data would be desirable. Author

**N91-32445#** Centre d'Etudes et de Recherches, Toulouse (France). Complexe Scientifique de Rangueil.

**CALCULATION OF TURBULENT COMPRESSIBLE FLOWS**

J. Cousteix *In* AGARD, Appraisal of the Suitability of Turbulence Models in Flow Calculations Jul. 1991 20 p (For primary document see N91-32443 24-34)

Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The use and the suitability is discussed of turbulence models for calculating compressible flows in aerodynamics. As the compressible form of turbulence models is generally extended from a basic incompressible form, the emphasis is placed on the pertinence of these extensions and on the peculiarities of compressible flows. Author

**N91-32446#** Karlsruhe Univ. (Germany, F.R.). Inst. for Hydromechanics.

**SOME CURRENT APPROACHES IN TURBULENCE MODELLING**

W. Rodi *In* AGARD, Appraisal of the Suitability of Turbulence Models in Flow Calculations Jul. 1991 10 p Sponsored in part by DFG (For primary document see N91-32443 24-34)

Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Some recent work is reviewed in the area of modeling turbulence in near wall regions and by Reynolds stress equation models. Various low Reynolds number versions of the kappa-epsilon model and damping functions are examined with the aid of results from direct numerical simulations and they are compared with respect to their performance in calculating boundary layers under adverse and favorable pressure gradients. A two layer model is presented in which near wall regions are resolved with a one equation model and the core region with the standard kappa-epsilon model. Various applications of this model are shown. The ability of various models to simulate laminar-turbulent transition in boundary layers is discussed. Recent applications of a fairly simple, standard Reynolds stress equation model to two complex flow of practical interest are presented. Finally, some recent proposals for improved Reynolds stress equation models are presented and an outlook is provided on possible future turbulence model developments. Author

**N91-32447#** Patras Univ. (Greece). Lab. of Applied Thermodynamics.

**TURBULENCE MODELS FOR NATURAL CONVECTION FLOWS ALONG A VERTICAL HEATED PLANE**

D. D. Papailiou *In* AGARD, Appraisal of the Suitability of Turbulence Models in Flow Calculations Jul. 1991 8 p (For primary document see N91-32443 24-34)

Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The state of development of turbulent models is reviewed which are currently used in the computation of turbulent free convection flows along heated plane surfaces. Some experimental results recently obtained are also compared with corresponding computations in which existing turbulence models were also used. There is a lack of sufficient knowledge regarding the effects of buoyancy on the turbulence structure of flows such as plumes, buoyant jets, and thermal flow, and also buoyancy's participation and role in the corresponding transport processes. The reasons causing this inadequacy of necessary information is discussed. As a consequence, in computing buoyancy induced flows, turbulent transport models are adopted from forced convection or ordinary flows, mostly in modified forms. Author

**N91-32448#** Zaragoza Univ. (Spain). Fluid Mechanics Group.

**TURBULENT FLOW MODELLING IN SPAIN: OVERVIEW AND DEVELOPMENTS**

C. Dopazo, R. Aliod, and L. Valino *In* AGARD, Appraisal of the Suitability of Turbulence Models in Flow Calculations Jul. 1991 13 p (For primary document see N91-32443 24-34)

Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A brief overview of ongoing flow modelling activities in the fields of turbulent boundary layers, two phase flows, and turbulent reactive flows is presented. Turbulent shear flows laden with small solid particles and the turbulent isothermal mixing of two chemical species undergoing a second order irreversible chemical reaction are discussed. An Eulerian approach is followed in the former, using a phase indicator function conditioning technique for the continuous phase and a Boltzmann type velocity distribution function for the dispersed phase. The latter is treated via a probability density function (pdf) formalism where the joint statistics of concentrations and concentration gradients is studied. Predictions are compared with available experimental results in both cases. Author

**N91-32449#** Turkish Aerospace Industries, Ankara.

**COMPUTATIONAL TURBULENCE STUDIES IN TURKEY**

Unver Kaynak *In* AGARD, Appraisal of the Suitability of Turbulence Models in Flow Calculations Jul. 1991 8 p (For primary document see N91-32443 24-34)

Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Applications of various turbulence models to different flow problems that were recently carried out in Turkey are presented. Navier-Stokes, boundary layer, and vorticity stream function methods are used to solve 2-D or 3-D steady and/or unsteady flow problems. Examples are given in low speed and transonic flow regimes for axisymmetric bodies, airfoils, rigid ripples, and jet flows. Different turbulence models are used such as algebraic, half equation, and k-epsilon models. It is shown that improved accuracies can be obtained by using the so-called half equation (nonequilibrium) turbulence model for some 3-D configurations. Suitability of different turbulence models is explored for a variety of flow cases such as dynamic stall, jets in crossflow, and oscillatory boundary layers. Author

**N91-32450#** Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
**APPRAISAL OF THE SUITABILITY OF TURBULENCE MODELS IN FLOW CALCULATIONS: A UK VIEW ON TURBULENCE MODELS FOR TURBULENT SHEAR FLOW CALCULATIONS**
G. M. Lilley *In* AGARD, Appraisal of the Suitability of Turbulence Models in Flow Calculations Jul. 1991 15 p (For primary document see N91-32443 24-34)
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The background and basis is examined for the different models of turbulence as currently used for solutions to the Reynolds averaged Navier-Stokes equations. It is concluded that no model of turbulence as currently used is fully satisfactory, although many computer codes may legitimately claim to give results to engineering accuracy. The need is stressed to provide means for calibrating all CFD computer codes against good, reliable, independently assessed experimental data. Attention is drawn to a need for a reassessment of the central role claimed in turbulence modeling for the six independent components of the Reynolds Stress Tensor. There is also a need to replace the term eddy viscosity by a term that more accurately expresses the large scale turbulent mixing process in a turbulent flow. Author

**N91-32451#** Stanford Univ., CA. Dept. of Mechanical Engineering.
**COLLABORATIVE TESTING OF TURBULENCE MODELS**
Peter Bradshaw *In* AGARD, Appraisal of the Suitability of Turbulence Models in Flow Calculations Jul. 1991 5 p (For primary document see N91-32443 24-34)
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A review is given of an ongoing international project, in which data from experiments on, and simulations of, turbulent flows are distributed to developers of (time averaged) engineering turbulence models. The predictions of each model are sent to the organizers and redistributed to all the modellers, plus some experimentalists and other experts. The organizers' inspection of the results has identified several discrepancies which were traced to numerical errors. Author

**N91-32452#** Los Alamos National Lab., NM.
**DETERMINING FINITE VOLUME ELEMENTS FOR THE 2D NAVIER-STOKES EQUATIONS**
D. A. Jones and E. S. Titi (California Univ., Irvine.) 1991 20 p Presented at the Experimental Mathematics: Computational Issues in Nonlinear Science, Los Alamos, NM, 20-24 May 1991
(Contract W-7405-eng-36)
(DE91-016028; LA-UR-91-2330; CONF-9105242-1) Avail: NTIS HC/MF A03

We consider the 2D Navier-Stokes equations on a square with periodic boundary conditions. Dividing the square into N equal subsquares, we show that if the asymptotic behavior of the average of solutions on these subsquares (finite volume elements) is known, then the large time behavior of the solution itself is completely determined, provided N is large enough. We also establish a rigorous upper bound for N needed to determine the solutions to the Navier-Stokes equation in terms of the physical parameters of the problem. DOE

**N91-32453#** Sandia National Labs., Albuquerque, NM.
**CHANNEL FLOW OF A CONCENTRATED SUSPENSION**
D. F. McTigue and J. T. Jenkins (Cornell Univ., Ithaca, NY.) 1991 12 p Presented at the 2nd US-Japan Seminar on Micromechanics of Granular Materials, Syracuse, NY, 4-10 Aug. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016649; SAND-91-1623C; CONF-9108127-1) Avail: NTIS HC/MF A03

A theory for creeping flow of concentrated suspensions is described that takes into account the fluctuations of particles about their mean motion. The intensity of the velocity fluctuations is characterized by an internal field analogous to the temperature in classical kinetic theories, and governed by a balance law for the fluctuation energy. Explicit forms are posed for the constitutive models relating the viscosity, conductivity, dissipation, and pressure to the temperature and mean interparticle separation. Flow between parallel plates is considered; exact and approximate solutions are found for the temperature and separation fields. The mean velocity is given in terms of a simple integral involving the temperature. The solution exhibits qualitative behavior comparable to experimental observations: particle fluctuations and the mean shearing are confined to a region near the channel wall, while a plug-like region prevails in the center. DOE

**N91-32454#** Michigan State Univ., East Lansing.
**STUDY OF FLOW PROPERTIES OF WET SOLIDS USING LASER INDUCED PHOTO CHEMICAL ANEMOMETRY**
B. Falco 25 May 1991 8 p
(Contract DE-AC22-88PC-88948)
(DE91-016877; DOE/PC-88948/T1) Avail: NTIS HC/MF A02

Research continued on flow properties of wet solids. This quarter we have set up the data acquisition system to obtain two-color solid and liquid laser induced photochemical anemometry (LIPA) flow diagnostics separately and simultaneously; obtained qualitative flow visualization of the thicker core/more liquid annulus flow using a crude skimmer; continued to make more red Europium imbedded CaF2, which we want to use as the solid phase material that is photoluminescent, as well as more green Flowlite for the liquid phase; and made progress improving our grid line detection data analysis scheme to allow for it to automatically detect the grid intersections that are distorted by more than a small amount. DOE

**N91-32455#** California Univ., Berkeley. Lawrence Berkeley Lab.
**NUMERICAL STUDY OF STOKES FLOWS WITH SUSPENDED PARTICLES Ph.D. Thesis**
Eric Yu Tau (California Univ., Berkeley.) Jul. 1991 68 p
(Contract DE-AC03-76SF-00098)
(DE91-017011; LBL-30963) Avail: NTIS HC/MF A04

We solve the Stokes equations in three space dimensions in the region outside a collection of spheres, with and without an outer boundary. The method of solution is the reflection method, in which one iteratively solves the problem outside each single sphere. The idea is to reduce the problem of finding a Stokes flow past a number of particles to a series of problems of finding a Stokes flow past one single particle. Our method can also be used to find the motion of sedimenting spheres. We demonstrate numerically the convergence of the method for all sphere configurations in case of unbounded domains. We use the method to find periodic solutions of the problem of three sedimenting spheres in a Stokes fluid. Long time periodic solutions are obtained when the initial positions of the spheres are symmetric and modulated long time scale periodic solutions are obtained when the initial positions are asymmetric. We further develop a fast numerical algorithm for the solution of steady Stokes equations in a bounded domain in both two and three dimensions. The method is second order accurate and has an operation count of order O(N log N) where N is the number of grid points in the domain. We then use this algorithm to extend the method of reflections to bounded domains. The convergence of the method in this case is studied for various spheres configurations. The method is used to evaluate the effective viscosity of fluid with suspended spheres in a shear flow. DOE

**N91-32456#** Oak Ridge National Lab., TN.
**PARALLELIZING THE SPECTRAL TRANSFORM METHOD, PART 2**
D. W. Walker, P. H. Worley, and J. B. Drake Jul. 1991 27 p
(Contract DE-AC05-84OR-21400)
(DE91-017131; ORNL/TM-11855-Pt-2) Avail: NTIS HC/MF A03

This paper describes the parallelization and performance of the spectral method for solving the shallow water equations on the surface of a sphere using a 128-node Intel iPSC/860 hypercube. The shallow water equations form a computational kernel of more

complex climate models. This work is part of a research program to develop climate models that are capable of much longer simulations at a significantly finer resolution than current models. Such models are important in understanding the effects of the increasing atmospheric concentrations of greenhouse gases, and the computational requirements are so large that massively parallel multiprocessors will be necessary to run climate models simulations in a reasonable amount of time. The spectral method involves the transformation of data between the physical, Fourier, and spectral domains. Each of these domains is two-dimensional. The spectral method performs Fourier transforms in the longitude direction followed by summation in the latitude direction to evaluate the discrete spectral transform. A simple way of parallelizing the spectral code is to decompose the physical problem domain in just the latitude direction. This allows an optimized sequential FFT algorithm to be used in the longitude direction. However, this approach limits the number of processors that can be brought to bear on the problem. Decomposing the problem over both directions allows the parallelism inherent in the problem to be exploited more effectively - the grain size is reduced and more processors can be used. Results are presented that show that decomposing over both directions does result in a more rapid solution of the problem. The importance of minimizing communication latency and overlapping communication with calculation is stressed. General methods for doing this, that may be applied to many other problems, are discussed. DOE

**N91-32457#** Lawrence Livermore National Lab., CA.
**SIMULATION OF SINGLE MODE RICHTMYER-MESHKOV INSTABILITY USING THE ADAPTIVE FREE LAGRANGE METHOD**
D. E. Burton and A. K. Harrison Jun. 1991 9 p Presented at the Workshop on Physics of Compressible, Turbulent Mixing, Royaumont, France, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE91-017657; UCRL-JC-108033; CONF-9106222-6) Avail: NTIS HC/MF A02

Because of extreme deformation, instability problems have been traditionally modeled using Eulerian techniques or Arbitrary Lagrange Euler (ALE) techniques. The free-Lagrange (FL) method first introduced by Crowley offers a third basic alternative. The specific FL method described in this paper consists of (1) a 2D staggered-grid hydrodynamics (SGH) differencing scheme appropriate to an unstructured mesh consisting of triangular and quadrilateral zones; (2) a set of primitive mesh optimization algorithms; and (3) a set of rules for adaptive mesh refinement which we refer to as the adaptive free Lagrange (AFL) method. In a previous study, Burton showed that the spurious vorticity commonly associated with SGH differencing results from a failure to explicity conserve angular momentum in the difference equations. This led to a significantly improved technique for removing the spurious vorticity, called spurious vorticity damping (SVD). SVD was shown to produce superior results in a test problem which had no intrinsic vorticity. In the present study, SVD is shown to also produce superior results in a problem with intrinsic vorticity. The AFL and SVD methods are applied to a low Mach number shock tube problem and compared with other methods. AFL seems to perform as well as Eulerian methods and is somewhat better at resolving fine structures in the calculation. The SVD method produced results far superior to other methods tried. DOE

**N91-32458*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**RESONANT TRIAD IN BOUNDARY-LAYER STABILITY. PART 1: FULLY NONLINEAR INTERACTION**
Reda R. Mankbadi Sep. 1991 57 p
(NASA-TM-105208; E-5233-1-Pt-1; NAS 1.15:105208) Avail: NTIS HC/MF A04 CSCL 20D

A first principles theory is developed to study the nonlinear spatial evolution of a near-resonance triad of instability waves in boundary layer transition. This triad consists of a plane wave at fundamental frequency and a pair of symmetrical, oblique waves at the subharmonic frequency. A low frequency, high Reynolds number asymptotic scaling leads to a distinct critical layer where nonlinearity first becomes important; the development of the triad's waves is determined by the critical layer's nonlinear, viscous dynamics. The resulting theory is fully nonlinear in that all nonlinearly generated oscillatory and nonoscillatory components are accounted for. The presence of the plane wave initially causes exponential of exponential growth of the oblique waves. However, the plane wave continues to follow the linear theory, even when the oblique waves' amplitude attains the same order of magnitude as that of the plane wave. A fully interactive stage then comes into effect when the oblique waves exceed a certain level compared to that of the plane wave. The oblique waves react back on the fundamental, slowing its growth rate. The oblique waves' saturation results from their self-interaction - a mechanism that does not require the presence of the plane wave. The oblique waves' saturation level is independent of their initial level, but decreases as the obliqueness angle increases. Author

**N91-32459*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**RESONANT TRIAD IN BOUNDARY-LAYER STABILITY. PART 2: COMPOSITE SOLUTION AND COMPARISON WITH OBSERVATIONS**
Reda R. Mankbadi Sep. 1991 57 p
(NASA-TM-105209; E-6045-1-Pt-2; NAS 1.15:105209) Avail: NTIS HC/MF A04 CSCL 20D

Here, numerical results are computed from an asymptotic near-resonance triad analysis. The analysis considers a resonant triad of instability waves consisting of a plane fundamental wave and a pair of symmetrical oblique subharmonic waves. The relevant scaling ensures that nonlinearity is confined to a distinct critical layer. The analysis is first used to form a composite solution that accounts for both the flow divergence and nonlinear effects. It is shown that the backreaction on the plane Tollmien Schlichting (TS) fundamental wave, although fully accounted for, is of little significance. The observed enhancement at the fundamental frequency disturbance is not in the plane TS wave, but is caused by nonlinearly generated waves at the fundamental frequency that result from nonlinear interactions in the critical layer. The saturation of the oblique waves is caused by their self-interaction. The nonlinear phase-locking phenomenon, the location of resonance with respect to the neutral stability curve, low frequency effects, detuning in the streamwise wave numbers, and nonlinear distortion of the mode shapes are discussed. Nonlinearity modifies the initially two dimensional Blasius profile into a fuller one with spanwise periodicity. The interactions at a wide range of unstable spanwise wave numbers are considered, and the existence of a preferred spanwise wave number is explained by means of the vorticity distribution in the critical layer. Besides presenting novel features of the phenomena and explaining the delicate mechanisms of the interactions, the results of the theory are in excellent agreement with experimental and numerical observations for all stages of the development and for various input parameters. Author

**N91-32460*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**A k-EPSILON MODELING OF NEAR WALL TURBULENCE**
Z. Yang and T. H. Shih Sep. 1991 14 p Presented at the Fourth International Symposium on Computational Fluid Dynamics, Davis, CA, 9-12 Sep. 1991
(NASA Order C-99066-G)
(NASA-TM-105238; E-6563; ICOMP-91-16; CMOTT-91-06; NAS 1.15:105238) Avail: NTIS HC/MF A03 CSCL 20D

A k-epsilon model is proposed for turbulent bounded flows. In this model, the turbulent velocity scale and turbulent time scale are used to define the eddy viscosity. The time scale is shown to be bounded from below by the Kolmogorov time scale. The dissipation equation is reformulated using the time scale, removing the need to introduce the pseudo-dissipation. A damping function is chosen such that the shear stress satisfies the near wall asymptotic behavior. The model constants used are the same as the model constants in the commonly used high turbulent Reynolds number k-epsilon model. Fully developed turbulent channel flows

and turbulent boundary layer flows over a flat plate at various Reynolds numbers are used to validate the model. The model predictions were found to be in good agreement with the direct numerical simulation data. Author

**N91-32461** Catholic Univ. of America, Washington, DC.
**TEMPORAL AND SPECTRAL FEATURES OF WALL PRESSURE FLUCTUATIONS BENEATH A TURBULENT BOUNDARY LAYER Ph.D. Thesis**
Carolyn Ceder Karangelen 1991 226 p
Avail: Univ. Microfilms Order No. DA9123093

Experimental data on the temporal and spectral characteristics of wall pressure fluctuations were acquired and analyzed with the goal of identifying the coherent structures in the turbulent boundary layer which include them. Two different approaches were pursued in the examination of the data. The complete pressure records were analyzed using long-time averaging techniques to determine global statistics and power, cross and wavenumber spectral features. In addition, pressure records were conditionally sampled to detect large amplitude events which were then analyzed to determine their unique temporal and spectral features. The large amplitude events appear to be a major contributor to the power of the wall pressure field and are thought to be induced by coherent structures associated with the near-wall bursting process. This conjecture is based on the similarity of the characteristic features for both burst events and wall pressure events including event duration, convection speed, frequency of occurrence, and spectral content. A secondary aspect of this research was to investigate the analytical models for fluid/structure coupling mechanisms. Utilizing an extensive cross spectral database, the wavenumber frequency spectrum was computed and compared to the widely used Corcos model. Several of the basic assumptions inherent to the Corcos model were questioned. Dissert. Abstr.

**N91-32462*#** Old Dominion Univ., Norfolk, VA. Inst. for Computational and Applied Mechanics.
**INFRARED RADIATIVE ENERGY TRANSFER IN GASEOUS SYSTEMS Progress Report, Sep. 1991**
Surendra N. Tiwari Sep. 1991 200 p
(Grant NAG1-363)
(NASA-CR-188925; NAS 1.26:188925; ODU/ICAM-91-102)
Avail: NTIS HC/MF A09 CSCL 20D

Analyses and numerical procedures are presented to investigate the radiative interactions in various energy transfer processes in gaseous systems. Both gray and non-gray radiative formulations for absorption and emission by molecular gases are presented. The gray gas formulations are based on the Planck mean absorption coefficient and the non-gray formulations are based on the wide band model correlations for molecular absorption. Various relations for the radiative flux and divergence of radiative flux are developed. These are useful for different flow conditions and physical problems. Specific plans for obtaining extensive results for different cases are presented. The procedure developed was applied to several realistic problems. Results of selected studies are presented. Author

**N91-32463*#** Institute for Computer Applications in Science and Engineering, Hampton, VA.
**AN APPROXIMATE RIEMANN SOLVER FOR HYPERVELOCITY FLOWS Final Report**
Peter A. Jacobs Sep. 1991 16 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187629; NAS 1.26:187629; ICASE-91-75) Avail: NTIS HC/MF A03 CSCL 20D

We describe an approximate Riemann solver for the computation of hypervelocity flows in which there are strong shocks and viscous interactions. The scheme has three stages, the first of which computes the intermediate states assuming isentropic waves. A second stage, based on the strong shock relations, may then be invoked if the pressure jump across either wave is large. The third stage interpolates the interface state from the two initial states and the intermediate states. The solver is used as part of a finite-volume code and is demonstrated on two test cases. The first is a high Mach number flow over a sphere while the second is a flow over a slender cone with an adiabatic boundary layer. In both cases the solver performs well. Author

**N91-32464#** Texas Univ., Austin. Inst. for Fusion Studies.
**HAMILTONIAN CHAOS AND TRANSPORT IN QUASIGEOSTROPHIC FLOWS**
D. delCastillo and P. J. Morrison 12 Apr. 1991 34 p Presented at the International Topical Conference on Chaotic Dynamics and Transport in Fluids and Plasmas, La Jolla, CA, 18-20 Feb. 1991
(Contract DE-FG05-80ET-53088)
(DE91-017385; DOE/ET-53088/492; IFSR-492; CONF-910250-1)
Avail: NTIS HC/MF A03

Chaotic advective transport in quasigeostrophic flows is studied. Particular interest is to compare theory with recent rotating tank experiments. Ideas regarding chaotic advection are briefly reviewed. A derivation of the quasigeostrophic equation relevant to the tank experiments is given, from which a model for the stream function is extracted and compared to experimental data. Linear theory is shown to predict correctly the onset of observed sinuous Rossby waves. A model stream function, composed of a zonal flow equilibrium with linear eigenfunctions, is used to study chaotic transport. Upon applying the Chirikov overlap criterion to the model it is seen, in agreement with experiments, that banded chaos, i.e., regions of chaos bounded by invariant surfaces, is to be expected. It is also shown that global chaos, and hence transport across the zonal flow, is inconsistent with linear theory and in general requires resonances with phase velocities near the peak velocity of the zonal flow equilibrium. Speculations regarding the consistency of chaos and conservation of potential vorticity are made. DOE

**N91-32465#** Stanford Univ., CA. School of Engineering.
**FLUID DYNAMICS OF DOUBLE DIFFUSIVE SYSTEMS**
J. R. Koseff 15 Apr. 1991 16 p
(Contract DE-FG03-87ER-13757)
(DE91-017401; DOE/ER-13757/T1) Avail: NTIS HC/MF A03

A study of mixing processes in doubly diffusive systems is being conducted. Continuous gradients of two diffusing components (heat and salinity in our case) are being used as initial conditions, and forcing is introduced by lateral heatings and surface shear. The goals of the proposed work include: (1) quantification of the effects of finite amplitude disturbances on stable, double diffusive systems, particularly with respect to lateral heating, (2) development of an improved understanding of the physical phenomena present in wind-driven shear flows in double diffusive stratified environments, (3) increasing our knowledge-base on turbulent flow in stratified environments and how to represent it, and (4) formulation of a numerical code for such flows. The work is being carried out in an experimental facility which is located in the Stanford Environmental Fluid Mechanics Laboratory, and on laboratory minicomputers and CRAY computers. In particular, our overall goals are as follows: (1) develop more general stability and scaling criteria for the destabilization of doubly-stratified systems, (2) further study the variation of flow structure and scales with Rayleigh ratio and lateral heating ratio, (3) further delineate the mechanisms governing convective layer formation and merging, (4) study the mixing processes within the convective layers and across interfaces, and estimate the heat and mass fluxes in such a system, (5) quantify the effects of turbulence and coherent structures (due to a wind-driven surface shear) on a doubly stratified system, and (6) study the interaction between surface shear and side-wall heating destabilization mechanisms. DOE

**N91-32466#** Purdue Univ., West Lafayette, IN. School of Nuclear Engineering.
**MEASUREMENT OF INTERFACIAL AREA USING FOUR SENSOR PROBE IN TWO PHASE FLOW**
M. Ishii and S. T. Revankar Jul. 1991 48 p
(Contract DE-FG02-90ER-14147)
(DE91-017415; DOE/ER-14147/1) Avail: NTIS HC/MF A03

The knowledge of the interfacial area concentration is essential in the formulation of two-phase models such as in two-fluid model.

A theoretical foundation of the measurement method for the time averaged local interfacial area using a four sensor resistivity probe is presented. Based on this theory, the four sensor resistivity probe was employed for the measurement of local properties of two-phase flow such as the interfacial velocity, local interfacial area concentration and void fraction in a vertical air-water cap bubbly flow. Experimental data are presented on the radial profiles of the void fraction and interfacial area concentration at various gas flow rates. The four sensor probe measurements are checked against the global void measurement using a differential pressure. The result is very satisfactory. Theoretical profiles of the void fraction and interfacial area concentration were obtained using the pictures of cap bubbles. The theoretical predictions of the cap bubbles and the interfacial area concentration profiles compared very well with the four sensor data. DOE

**N91-32467#** Lawrence Livermore National Lab., CA.
**A TWO-DIMENSIONAL DYNAMIC MIX MODEL IN FREE LAGRANGE HYDRODYNAMICS**
A. K. Harrison and D. E. Burton Jun. 1991 8 p Presented at the Workshop on Physics of Compressible, Turbulent Mixing, Royaumont, France, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE91-017661; UCRL-JC-108032; CONF-9106222-8) Avail: NTIS HC/MF A02

We are developing a set of dynamic mix algorithms compatible with two-dimensional free Lagrange hydrodynamics. The hydrodynamics algorithms have conservation properties desirable to minimize numerical noise that might otherwise unacceptably degrade the second order moment terms coupling turbulence to the underlying flow. The mix model will consist of a k-eplison model of isotropic turbulence and a set of instability models based on multiphase hydrodynamics. The k-epsilon model has been tested and has given qualitatively correct results. The instability model is intended to account for subgrid-scale flows which are not yet fully turbulent or well mixed and thus do not conform to the assumptions of the turbulence model. By basing these algorithms on the variables of multiphase hydrodynamics, we will model the effects of subgrid-scale interface and mixing layer structure on variables relevant to mixing, without modeling the subgrid-scale structure explicitly. DOE

**N91-32036#** Nissan Motor Co. Ltd., Tokyo (Japan).
**NUMERICAL SIMULATIONS OF CHEMICALLY REACTING FLOW**
Kenichi Hirai *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 33-37 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32040#** Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
**AN INCOMPRESSIBLE FLOW SOLVER**
Wei Jia, Yoshiaki Nakamura, and Michiru Yasuhara *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 53-62 (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32041#** Kyushu Univ., Fukuoka (Japan). Dept. of Mechanical Engineering for Power.
**NUMERICAL SIMULATION OF UNSTEADY COMPRESSIBLE VISCOUS FLOWS USING AN IMPLICIT UPWIND RELAXATION SCHEME**
Masato Furukawa, Takashi Nakano, and Masahiro Inoue *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 69-75 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32044#** Institute of Computational Fluid Dynamics, Tokyo (Japan).
**SEVERAL ISSUES OF VISUALIZATION TECHNIQUES IN COMPUTATIONAL FLUID DYNAMICS 2**
Susumu Shirayama *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 97-102 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32048#** Kawasaki Heavy Industries Ltd., Gifu (Japan).
**THE ROLE OF COMPUTATIONAL FLUID DYNAMICS IN AERONAUTICAL ENGINEERING (8): A MIXED COMPRESSION INLET FOR A SUPERSONIC AIRPLANE**
Akira Fujimoto, Nobuo Niwa, and Keisuke Sawada (Tohoku Univ., Sendai, Japan ) *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 121-126 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32052#** Kyoto Univ. (Japan). Dept. of Aeronautics.
**NUMERICAL ANALYSIS OF BUBBLY LIQUID IN CONVERGENT-DIVERGENT NOZZLE**
Ryuji Ishii, Yoshikuni Umeda, Shigeki Morioka, and Natsuo Hatta *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 147-151 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32053#** National Aerospace Lab., Kakuda (Japan).
**NUMERICAL TREATMENT OF LAMINAR FLOW IN CURVED RECTANGULAR CHANNELS WITH ENTRANCE REGION**
Hitoshi Yamada, Hiroshi Ishigaki, and Munekazu Mochizuki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 153-157 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32054#** National Aerospace Lab., Kakuda (Japan).
**DEVELOPING LAMINAR FLOW AND HEAT TRANSFER IN ORTHOGONALLY ROTATING SQUARE DUCTS**
Hiroshi Tamura and Hiroshi Ishigaki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 159-163 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32055#** National Aerospace Lab., Kakuda (Japan).
**FLOW AND HEAT TRANSFER IN A CURVED ANNULAR PIPE**
Munekazu Mochizuki and Hiroshi Ishigaki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 165-171 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32056#** National Aerospace Lab., Kakuda (Japan).
**TURBULENCE MODEL CALCULATIONS ON THE EFFECTS OF BODY FORCES ON TURBULENT FLOWS IN A PIPE**
Hiroshi Ishigaki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 173-179 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32057#** National Aerospace Lab., Kakuda (Japan).
**FULLY DEVELOPED MIXED CONVECTION IN A HORIZONTAL PIPE**
Hiroshi Ishigaki and Munekazu Mochizuki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft

Computational Aerodynamics Nov. 1990 p 181-185 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32058#** Ship Research Inst., Tokyo (Japan).
**WALL FUNCTION METHOD WITH CONSERVATION PROPERTY**
Takanori Hino *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 187-192 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32059#** Tokyo Noko Univ. (Japan).
**ACTIVE CONTROL OF VORTEX SHEDDING FREQUENCY BY A SPLITTER PLATE**
Norio Arai, Masatomo Komatsu, and Takashi Tani *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 193-196 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32060#** Fuji Heavy Industries Ltd., Utsunomiya (Japan).
**A NUMERICAL SIMULATION OF TWO DIMENSIONAL SHEAR LAYER**
Yasuhiro Koshioka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 197-202 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32061#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL SIMULATION OF SHOCK WAVE EMANATING FROM A SQUARE SHOCK TUBE**
Akihisa Abe, Katsuhiro Itoh, and Kazuyoshi Takayama (Tohoku Univ., Sendai, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 203-208 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32062#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL SIMULATION OF THERMAL CONVECTION IN A RECTANGULAR DUCT FLOW**
Kiyoshi Yamamoto, Iwao Hosokawa, and Yoshinori Tanaka (University of Electro-Communications, Chofu, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 209-214 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32063#** Tohoku Univ., Sendai (Japan). Dept. of Mechanical Engineering.
**NUMERICAL TURBULENT SIMULATIONS OF UNSTEADY TRANSONIC CASCADE FLOWS**
Satoru Yamamoto, Hisaaki Daiguji, and Kouichi Ishizaka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 215-220 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32064#** National Aerospace Lab., Tokyo (Japan).
**UNSTEADY FLOW ANALYSIS IN TWO-DIMENSIONAL COMPRESSOR CASCADE**
Masahiro Fukuda, Kazuo Kikuchi, Atsuhiro Tamura, Keisuke Hashimoto, and Akinori Matsuoka (Kawasaki Heavy Industries Ltd., Kakamigahara, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 221-226 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32067#** National Aerospace Lab., Tokyo (Japan).
**NUMERICAL ANALYSIS OF THREE-DIMENSIONAL CASCADE FLOW**
Yuichi Matsuo *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 239-244 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32068#** National Aerospace Lab., Tokyo (Japan).
**NAVIER-STOKES COMPUTATIONS OF THREE-DIMENSIONAL TURBINE CASCADE FLOWS**
Kazuo Kikuchi, Osamu Nozaki, Atsuhiro Tamura, Takehiko Nagayama, and Yoshiaki Miyake (Mitsubishi Heavy-Industries Ltd., Nagasaki, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 245-248 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32069#** National Aerospace Lab., Tokyo (Japan).
**APPLICATION OF 3-D NAVIER-STOKES COMPUTATION TO TURBINE VANE DESIGN**
Kazuo Kikuchi, Osamu Nozaki, Atsuhiro Tamura, Koji Matsunaga, Hisao Takeuchi, Takasi Maya, and Ruriko Yamawaki (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan ) *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 249-255 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

# 35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

**N91-32468#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Prozessortechnik.
**MODEL CALCULATIONS FOR A PUSHBROOM STEREO CAMERA: THE CASE OF THE MARS 94 HIGH RESOLUTION STEREO CAMERA (HRSC)**
Marc Buma, Jens Henkner, and Gottfried Schwarz Dec. 1990 198 p
(DLR-FB-90-57; ISSN-0939-2963; ETN-91-90037) Avail: NTIS HC/MF A09; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 63.50 DM

A guideline for the understanding of the often complex relationships between the requirements and the design parameters of a stereo camera for planetary remote sensing such as the High Resolution Stereo Camera (HRSC) proposed for the Mars 94 mission is given. Many questions arising during design, fabrication and operations can only be answered by calculations and numerical simulations. As a result, an attempt was made to establish a modular software package of model calculations which yield all their results as easily understandable plots. The model calculations include astronomical parameters, orbit data, viewing geometry, radiometry, contrast assessmennts, camera operations, and image analysis aspects. ESA

**N91-32469#** Beleidscommissie Remote Sensing, Delft (Netherlands).
**AN OPTICAL MULTICHANNEL ANALYSER BASED LARGE VOLUME REFLECTOMETER**
J. Krijgsman, G. B. J. Dubelaar, and H. Buiteveld (Instituut voor

Culturrtechniek en Waterhuishouding, Wageningen, Netherlands ) Mar. 1991 47 p
(BCRS-90-37; TD-91-2196; ETN-91-90050) Avail: NTIS HC/MF A03

A Large Volume Reflectometer (LVR) for the measurement of reflection properties of surface water is presented. The instrument and its function are described. A protocol for measurements using the collimated illumination is described. With this setup reflection spectra of demi water filtered over 0.45 microns pore size filters and untreated tap water were measured. Comparisons are made between absorption spectra derived from the LVR measurements and absorption spectra measured with a spectrophotometer for different concentrations of aquatic humus (yellow substance) and a clear, orange solution of the dye ecoline 236. ESA

**N91-32470#** Department of the Navy, Washington, DC.
**NON-INVASIVE PRESSURE MEASURING DEVICE AND METHOD Patent Application**
Jeanne A. Welch, inventor (to Navy) 26 Dec. 1990 20 p
(AD-D014949; US-Patent-Appl-SN-620108) Avail: NTIS HC/MF A03 CSCL 14/2

The invention relates generally to measuring devices and to devices for measuring the pressure in a sealed container. More particularly, the invention relates to a non-invasive device and method for measuring the pressure of a gas in a double-envelope lamp. An infrared gaseous discharge lamp of integrated double-envelope construction has an inner chamber or envelope filled with a gaseous medium under relatively high pressure which provides illumination when the lamp is energized. The outer chamber or envelope is normally evacuated or otherwise provided with a relatively low-pressure gas. Double-envelope lamps are subject to gas leaks from the inner chamber to the outer chamber. Eventually, these leaks may lead to catastrophic lamp failure by a mechanism that involves electric arcing in the outer chamber. GRA

**N91-32471#** Department of the Navy, Washington, DC.
**RESISTIVE GATE MAGNETIC FIELD SENSOR Patent Application**
Francis J. Kub, inventor (to Navy) 31 Dec. 1990 27 p
(AD-D014952; US-Patent-Appl-SN-636348) Avail: NTIS HC/MF A03 CSCL 09/1

The MISFET (Metal-Insulator-Semiconductor Field Effect Transistor) device of the invention comprises a buried channel conducting layer having a source at a first end of the buried channel conducting layer, and a drain at an opposite second end of the buried channel conducting layer, with the drain comprising a first drain having a first output, and a second drain having a second output, the first and second drains being separated by a charge splitter. The MOSFET device further comprises bias voltage means for providing a bias voltage producing movement of charge carriers between the source and the drain, within a buried channel conducting layer located within the silicon substrate material. The channel layer, in accordance with one aspect of the invention comprises a buried channel conducting layer formed in silicon material, while in another implementation, the channel layer is formed in a gallium arsenide based material. GRA

**N91-32472*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**SMART INSTRUMENTS AND THE NATIONAL COLLABORATORY**
Barry M. Leiner, ed. Nov. 1989 16 p
(Contract NCC2-387)
(NASA-CR-188902; NAS 1.26:188902; RIACS-TR-89-45) Avail: NTIS HC/MF A03 CSCL 14B

Here, we explore the process of scientific experimental investigation and ask what capabilities are required of the collaboratory to support such investigations. We first look at a number of examples of scientific research being conducted using remote instruments. We then examine the process of such research, asking at each stage what are the required capabilities. We finally integrate these results into a statement of the required set of capabilities needed to support scientific research in the future. Author

**N91-32473#** Lawrence Livermore National Lab., CA.
**SOME STABLE RECONSTRUCTION ALGORITHMS FOR ELECTRICAL IMPEDANCE TOMOGRAPHY**
J. G. Berryman Jul. 1991 15 p Presented at the International Conference on Inverse Problems/Computational Algorithms, College Station, TX, 10-14 Mar. 1991
(Contract W-7405-eng-48)
(DE91-016569; UCRL-JC-107990; CONF-9103194-1) Avail: NTIS HC/MF A03

An impedance camera or what is now more commonly called electrical impedance tomography -- attempts to image the electrical impedance (or just the conductivity) distribution inside a body using electrical measurements on its boundary. The method has been used successfully in both biomedical and geophysical applications but the analysis of optimal reconstruction algorithms is still progressing. The most common application is monitoring the influx or efflux of a highly conducting fluid (such as brine in a porous rock or blood in the human body) through the volume being imaged. For biomedical applications, this method does not have the resolution of radiological methods, but is is comparatively safe and inexpensive and therefore provides a valuable alternative when continuous monitoring of a patient or process is desired. The following discussion is intended first to summarize the physics of electrical impedance tomography, then to provide a few details of the data analysis and forward modeling requirements, and finally to outline some of the reconstruction algorithms that have proven to be most useful in practice. Pointers to the literature are provided throughout this brief narrative and the reader is encouraged to explore the references for more complete discussions of the variations issues raised here. DOE

**N91-32474*#** Sverdrup Technology, Inc., Brook Park, OH.
**THE INTERNAL CAUSTIC STRUCTURE OF ILLUMINATED LIQUID DROPLETS Final Report**
James A. Lock (Cleveland State Univ., OH.) and Edward A. Hovenac Sep. 1991 44 p
(Contract NAS3-25266)
(NASA-CR-187194; E-6516; NAS 1.26:187194) Avail: NTIS HC/MF A03 CSCL 20D

The internal electric field of an illuminated liquid droplet is studied in detail using both wave theory and ray theory. The internal field obtains its maximum values on the caustics within the droplet. Ray theory is used to determine the equations of these caustics and the density of rays on them. The Debye series expansion of the interior field Mie amplitudes is used to calculate the wave theory version of these caustics. The physical interpretation of the sources of stimulated Raman scattering and fluorescence emission within a liquid droplet is then given. Author

**N91-32475#** EG and G Energy Measurements, Inc., Pleasanton, CA.
**MEASUREMENT OF MODULATION TRANSFER FUNCTION FOR FOUR TYPES OF IMAGING ELEMENTS USED IN FAST CAMERAS**
R. M. Estrella, T. J. Sammons, and S. W. Thomas (Lawrence Livermore National Lab., CA.) 1991 7 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract DE-AC08-88NV-10617)
(DE91-017399; EGG-10617-4117; CONF-9107115-28) Avail: NTIS HC/MF A02

We have measured the modulation transfer function (MTF) of fiber optic bundles (reducers), minifiers (inverting, electrostatically focused imaging tube reducers), microchannel plate image intensifiers (MCPIs), and streak tubes as part of our ongoing device evaluation program aimed at precise characterization of various imaging elements used in fast cameras. This paper describes our measurement equipment and techniques and shows plots of MTF

measurements for each of four types of fast-camera elements tested. DOE

**N91-32476#** Argonne National Lab., IL.
**MAGNETO-OPTICAL RECORD MEDIA Patent Application**
G. Tanaka, inventor, T. Tokita, inventor, and T. Yuzubara, inventor 18 Oct. 1990 6 p Transl. into ENGLISH of Japanese Patent Application No. 63-269354, published 7 Nov. 1988 Filed 28 Apr. 1987
(Contract W-31-109-eng-38)
(DE91-017838; ANL-Trans-90-16) Avail: NTIS HC/MF A02

The invention relates to a magneto-optical recording media in which the magnetic film is prepared by alternately laminating a rare earth metal RE and a transition metal TM. The invention is comprised of a magneto-optical recording media comprised of magnetic film, on a substrate, with the following characteristics: a magnetic film made of alternate layers of, first, an ultra thin film that is 30 A thick and composed of a rare earth metal (however, the rare earth metal must be at least one Sm, Eu, Gd, Tb, Dy, or Ho) and then a 30 A thick transition metal (TM) layer (however, the TM must be at least one of Fe, Co, Ni, Cr, or Cu). DOE

**N91-32259*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**ANALYSIS OF A MULTIPLE RECEPTION MODEL FOR PROCESSING IMAGES FROM THE SOLID-STATE IMAGING CAMERA**
T.-Y. Yan *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 111-118 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 14B

**N91-32364#** Universite des Sciences et Techniques du Languedoc, Montpellier (France). Centre d'Electronique de Montpellier.
**LASER HEATED CALCIUM SULFATE TLD PLATES: APPLICATION TO RADIATION MAPPING**
K. Ed-Dahabi, F. Loup, O. Missous, G. Bruguier, H. Prevost, J. Fesquet, and J. Gasiot *In* ESA, ESA Electronic Components Conference Mar. 1991 p 469-472 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

# 36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

**N91-32477** Physics and Electronics Lab. TNO, The Hague (Netherlands).
**REFINEMENT OF A PULSED CO2-LASER RANGEFINDER WITH HETERODYNE DETECTION Interim Report**
C. P. Spruijt Feb. 1991 72 p
(Contract A89/KL/121)
(FEL-90-A303; TD-90-3537; ETN-91-99995) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

The development of a pulsed CO2 laser rangefinder and velocimeter is reported. An important change in the experimental set up consists of matching the laser beam diameters to the diameters of the beam expanders, resulting an improved profile of the emitted laser beam. This beam profile is completely described by a Gaussian intensity distribution. The present rangefinder, with heterodyne detection, has an effective range of circa 5 km in continuous mode and of circa 25 km in pulse mode. The loss factor of the heterodyne detection system corresponding with these ranges, is equal to the loss factors reported in the literature for similar systems. The collection of a database was initiated to determine the influence of meteorological parameters on the signal intensity and effective range. An outline of the theory of matched filtering is presented. This type of digital signal processing may increase both the range and the accuracy of the rangefinder. Initial results obtained with matched filtering are shown. ESA

**N91-32478#** Los Alamos National Lab., NM.
**SMALL SIGNAL GAIN FOR PARABOLIC PROFILE BEAMS IN FREE ELECTRON LASERS**
C. J. Elliott 1991 8 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-36)
(DE91-016236; LA-UR-91-2462; CONF-9107115-19) Avail: NTIS HC/MF A02

Three new types of free electrons lasers (FEL) that are being examined in new ranges of parameter design space are considered: compact system, extreme ultraviolet (EUV) systems, and high power devices. Shorter wiggler wavelengths, shorter or longer lasers, higher current, and higher quality electron beams are a few of the trends in the FEL community. The primary predictor of FEL oscillation is the small signal gain. We present 3-D small-signal calculations for more realistic parabolic-profile electron beams in the limit of moderately wide to wide electron beams. This limit complements the thin electron beam limit and needs be included in any analytical approximation that encompasses all 3-D effects. The system of equations for the optical modes are of Hamiltonian form and are solved as the analytical eigenmodes of the stationary quantum mechanical harmonic oscillator. We show the complete solution to the initial value problem in the special case of a cold, resonant electron beam, including the damped modes heretofore neglected. From this we derive the asymptotic solution of Hermite (square symmetry) or Laguerre (circular symmetry) modes. We give expressions for the mode size, the spatial growth rate and injection fraction for the dominant mode. DOE

**N91-32479#** Los Alamos National Lab., NM.
**APPLICATIONS OF SYNCHROSCAN AND DUAL-SWEEP STREAK CAMERA TECHNIQUES TO FREE-ELECTRON LASER EXPERIMENTS**
A. H. Lumpkin Jul. 1991 22 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-36)
(DE91-016017; LA-UR-91-2383; CONF-9107115-22) Avail: NTIS HC/MF A03

The results of several types of time resolved experiments on RF-linac driven free electron lasers (FELs) using streak camera techniques are presented. In the past these techniques generally traded off time resolution, time span, and timing jitter to address either submicropulse or submacropulse effects. More recently, we have taken advantage of synchroscan streak cameras that were phase-locked to the reference 108.3 MHz RF signal combined with an orthogonal slow ramp deflection. One can then obtain submicropulse, submacropulse, and phase information during a single 100 microsec long macropulse. Samples of results include electron beam bunch lengths, cavity length tuning, phase slew/jitter, drive-laser phase stability, and visible FEL output temporal effects. Several of these demonstrations are the first of their kind on a FEL system (to our knowledge). DOE

**N91-32480#** Los Alamos National Lab., NM.
**LASER-BASED DIAGNOSTICS FOR DENSITY, TEMPERATURE, VELOCITY, AND DISSOCIATION FRACTION IN HIGH TEMPERATURE HYDROGEN FLOWS**
A. D. Sappey and D. J. Funk 1991 12 p Presented at the AIAA/NASA/OAI Conference on Advanced SEI Technologies, Cleveland, OH, 3-4 Sep. 1991 Previously announced in IAA as A91-52337
(Contract W-7405-eng-36)
(DE91-016323; LA-UR-91-2495; CONF-9109226-5) Avail: NTIS HC/MF A03

This paper is essentially a review of the current state of the art in hydrogen atom and hydrogen molecule diagnostics. This paper contains some of our own results and ideas along with

results from many other laboratories. This is not intended to be an exhaustive review; instead it summarizes some techniques which we believe are ideally suited as diagnostics for high temperature hydrogen which are of paramount importance for the Space Exploration Initiative (SEI). DOE

**N91-32481#** Lawrence Livermore National Lab., CA.
**LASER PERFORMANCE AND OPTICAL PROPERTIES OF LiSrGaF6:Cr(3+)**
S. A. Payne, L. L. Chase, L. K. Smith, W. L. Kway, and B. H. T. Chai (University of Central Florida, Orlando.) Apr. 1991 6 p Presented at the Advanced Solid-State Lasers Topical Meeting, Hilton Head, SC, 18-20 Mar. 1991
(Contract W-7405-eng-48)
(DE91-016555; UCRL-JC-105398; CONF-9103110-2) Avail: NTIS HC/MF A02

The laser pumped laser performance of the new material LiSrGaF6:Cr(3+) has been characterized. The laser results indicate that the material operates with a high slope efficiency of 50 pct. due to the low passive, and pump-induced, loss levels. The optical and laser properties of Cr(3+) doped LiSrGaF6 are similar to those of the LiSrAlF6 host previously investigated, although the magnitude of the expansion coefficients of the gallium analog are more favorable. DOE

**N91-32482#** Lawrence Livermore National Lab., CA.
**HIGH AVERAGE POWER MAGNETIC MODULATOR FOR COPPER LASERS**
E. G. Cook, D. G. Ball, D. L. Birx, J. D. Branum, S. E. Peluso, M. D. Langford, R. D. Speer, J. R. Sullivan, and P. G. Woods 14 Jun. 1991 8 p Presented at the 8th IEEE Pulsed Power Conference, San Diego, CA, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE91-016560; UCRL-JC-105816; CONF-910640-34) Avail: NTIS HC/MF A02

Magnetic compression circuits show the promise of long life for operation at high average powers and high repetition rates. When the Atomic Vapor Laser Isotope Separation (AVLIS) Program at Lawrence Livermore National Laboratory needed new modulators to drive their higher power copper lasers in the Laser Demonstration Facility (LDF), existing technology using thyratron switched capacitor inversion circuits did not meet the goal for long lifetimes at the required power levels. We have demonstrated that magnetic compression circuits can achieve this goal. Improving thyratron lifetime is achieved by increasing the thyratron conduction time, thereby reducing the effect of cathode depletion. This paper describes a three stage magnetic modulator designed to provide a 60 kV pulse to a copper laser at a 4.5 kHz repetition rate. This modulator operates at 34 kW input power and has exhibited MTBF of approximately 1000 hours when using thyratrons and even longer MTBF's with a series stack of SCR's for the main switch. Within this paper, the electrical and mechanical designs for the magnetic compression circuits are discussed as are the important performance parameters of lifetime and jitter. Ancillary circuits such as the charge circuit and reset circuit are shown. DOE

**N91-32483#** Lawrence Livermore National Lab., CA.
**ZONAL DEFORMABLE MIRROR FOR LASER WAVEFRONT CONTROL**
C. D. Swift, J. W. Bergum, E. S. Bliss, F. A. House, M. A. Libkind, J. T. Salmon, and C. L. Weinzapfel 10 Jun. 1991 16 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-48)
(DE91-017085; UCRL-JC-105846; CONF-9107115-30) Avail: NTIS HC/MF A03

We have developed a zonal deformable mirror that controls the wavefront of a high average power visible laser beam used for isotope separation. The mirror corrects greater than five waves of astigmatism, power, or random second order aberrations to 1/20 wave RMS. Sufficient resolution is achieved to correct third order aberrations as well. A monolithic glass substrate with dimensions 77 mm x 121 mm x 10 mm is used in this design. Twenty-five actuator attachment members are incorporated into the shape of the back side of the substrate. Piezoelectric translators (PZTs) attached in a rectangular array deform the continuous substrate to the proper conjugate shape. The PZTs are attached through flexures designed to be compressionally stiff and laterally soft. In this way the intended PZT displacement is transmitted efficiently to the substrate while isolating both the mirror and the PZTs from undesirable lateral loads. Mirror parameters were determined from elastic mechanical beam approximations. Finite element analysis was used to verify performance prior to prototyping. A Hartmann sensor controls the mirror in a closed loop adaptive system. The system description is covered in a companion paper. This paper describes the mirror design and presents performance data. DOE

**N91-32484#** Los Alamos National Lab., NM.
**INTERFEROMETRIC RESULTS FROM BOEING GRAZING INCIDENCE RING RESONATOR FEL**
D. A. Byrd, S. C. Bender, E. L. Miller, and D. H. Dowell (Boeing Aerospace and Electronics Co., Seattle, WA.) 1991 14 p Presented at the 13th International Free-Electron Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 1991
(Contract W-7405-eng-36)
(DE91-016305; LA-UR-91-2549; CONF-9108118-1) Avail: NTIS HC/MF A03

The Boeing HAP (High Average Power) experiment had been reconfigured throughout 1989 to 1990 to incorporate a grazing incidence, 133 m round trip ring resonator. Initial spectral, mode stability, coherence length, and interferometric wavefront quality measurements have been taken. This paper reports on the optical measurement techniques and data used to characterize the resonator optical output as 2.0 to 2.5 lambda OPD. Raw data-reduction methodology and analysis supporting the subtraction of effects caused by the 7x beam reducer, fold mirrors, and the radial shear interferometer itself are included. Noteworthy observations such as the ability to overlay interferometric fringe data over the length of a macropulse (approx. 180 micropulses) without destroying the fringe visibility and the occurrence of centrally localized (approx. 30 pct. of the diameter) disturbances of the fringe pattern are also discussed. Coherence length measurements, made using the interferometer, showed the spectral bandwidth to be between 74 and 120 microns. Attempts to measure the micropulse-to-micropulse mode stability were made and are discussed as well. DOE

**N91-32485#** Oregon Univ., Eugene.
**MONITORING INTERFACIAL DYNAMICS BY PULSED LASER TECHNIQUES**
G. Richmond 1991 6 p
(Contract DE-FG06-86ER-45273)
(DE91-016950; DOE/ER-45273/5) Avail: NTIS HC/MF A02

The current work in the area of time resolved interfacial kinetics has centered on both semiconductor and metal electrode surfaces. The semiconductor studies have involved measurement of luminescence from the GaAs/liquid interface. The metal electrode studies have monitored thin film growth by second harmonic generation (SHG) during electrodeposition. The progress we have made over the past year is described in this report. DOE

**N91-32486#** Lawrence Livermore National Lab., CA.
**COHERENT-STATE DESCRIPTION OF FREE-ELECTRON LASERS**
Ching Tsung Lee (Alabama A & M Univ., Normal.) Dec. 1990 13 p
(Contract W-7405-eng-48)
(DE91-017077; UCRL-CR-103758-Suppl) Avail: NTIS HC/MF A03

It is generally accepted that the overall performance of free-electron lasers (FEL) can be understood without quantum mechanics. However, there are features of FEL such as photon statistics which can only be described quantum-mechanically. Although the majority of quantum-mechanical studies of FEL are devoted to one-particle models, there are also many studies on

many-body effects of FEL. Unfortunately, the mathematical derivations of these studies are so complicated that it is not easy to follow the developments with a clearer picture in mind. The origin of the problem is the quantum recoils of the electrons. So we try to gain a clearer picture of the many-body effects by making the recoilless approximation. A simple model of FEL consists of a beam of relativistic electrons propagating through a spatially periodic magnetostatic wiggler field. The resulting laser output is propagating along the same direction as that of the electron beam. Quantum-mechanical analysis of FEL are usually based on the Bambini-Renieri frame which moves in the same direction as the propagating laser beam with a relativistic speed so that: (1) the wiggler field appears almost as a plane-wave radiation, (2) the frequency of the wiggler field coincides with that of the laser, and (3) the electron motion is nonrelativistic. Although in reality the laser beam can only derive its energy at the expense of the kinetic energy of the electrons, it appears in the Bambini-Renieri frame as if the photons of the laser were scattered from the fictitious photons of the wiggler field by the electrons. DOE

**N91-32487#** Lawrence Livermore National Lab., CA.
**FUTURE DIRECTIONS OF LABORATORY X RAY LASER RESEARCH**
M. D. Rosen 1 May 1991 8 p Presented at the Conference on Short-Wavelength Coherent Radiation: Generation and Application, Monterey, CA, 4-10 Apr. 1991
(Contract W-7405-eng-48)
(DE91-017088; UCRL-JC-105739; CONF-9104164-6) Avail: NTIS HC/MF A02

We explore ways to make laboratory x-ray lasers and their applications more accessible to a wider community of users. This includes optical pump facilities that are affordable due to progress in optical laser technologies, from nsec 1KJ sources, to 100 fsec 1J tabletop sources. Based on these possibilities, the future for x-ray lasers seems bright. DOE

**N91-32488#** Imatran Voima Oy, Helsinki (Finland).
**LASER PROCESSING IN POWER PLANTS**
T. Muurman and M. Pitkaenen 1990 120 p
(DE91-527088; IVO-A-05/90) Avail: NTIS HC/MF A06

The present study has been made by Imatran Voima Oy in collaboration with the Lappeenranta University of Technology. The purpose is to illustrate the exploitation of laser processing in the building of power stations and in their maintenance. Tests show that the advantages of laser processing are most obvious in the area of laser cutting in applications with cutting thicknesses below 10 mm that are geometrically difficult and require great measurement accuracy. Laser cutting in power plant environments, in addiation to sheet cutting, can be particularly recommended for the wear-in cutting of T- and Y-arms of pipelines and segmental pieces of curved pipelines. The cutting process can also utilize computer-aided production techniques, i.e., CAD/CAM. Surface hardening and coating by lasers allow changes of the surface layer properties of the objects where necessary to meet the requirements of given operational conditions, without changing the mechanical properties of the base metal. Examples of required surface properties are fatigue strength and resistance to wear and corrosion. Typical to laser welding is low, carefullly controlled heat input. Also, high-speed welding with laser normally can be done without filler and surface contact. The laser application that is best fitted in power plants is welding of ready machined pieces, where no deformation is allowed and of other objects requiring carefully controlled heat input. Austenitic stainless steel, for example, is extremely well suited for laser welding. The dimensional changes are very small and there is no sensitizing risk. The strength of the weld compared with the base metal is good except for Ti-stabilized steel. DOE

**N91-32489*#** National Aeronautics and Space Administration. Pasadena Office, CA.
**QUANTUM WELL, BEAM DEFLECTING SURFACE EMITTING LASERS Patent Application**
Jae H. Kim, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 5 Jun. 1991 22 p
(Contract NAS7-918)
(NASA-Case-NPO-18243-1-CU; NAS 1.71:NPO-18243-1-CU; US-Patent-Appl-SN-710424) Avail: NTIS HC/MF A03 CSCL 20E

This invention relates to surface emitting semiconductor lasers (SELs), with integrated 45 deg. beam deflectors. A SEL is formed on a wafer including vertical mirrors and 45 deg. beam deflectors formed in grooves by tilted ion beam etching. A SEL is a lattice matched, or unstrained, AlGaAs/GaAs GRINSCH SQW SEL. An alternate embodiment is shown, in which a SEL is lattice mismatched, strained or pseudomorphic, or InGaAs/AlGaAs GRINSCH SQW SEL which emits radiation at a wavelength to which its substrate is transparent. Both SELs exhibit high output power, low threshold current density, and relatively high efficiency, and each are processing compatible with conventional large scale integration technology. Such SELs may be fabricated in large numbers from single wafers. The novel features of this invention include the use of tilted ion beam etching to form a pair of grooves each including vertical mirrors and 45 deg. beam deflectors. The embodiment provides substantial circuit design flexibility because radiation may be coupled both up and/or down through the substrate. NASA

**N91-32490#** Sandia National Labs., Albuquerque, NM.
**SYSTEM REQUIREMENTS FOR LOW-EARTH-ORBIT LAUNCH USING LASER PROPULSION**
R. J. Lawrence, R. M. Zazworsky, D. K. Monroe, and J. T. Kare (Lawrence Livermore National Lab., CA.) 1991 15 p Presented at the 6th International Conference on Emerging Nuclear Energy Systems, Monterey, CA, 16-21 Jun. 1991
(Contracts DE-AC04-76DP-00789; W-7405-eng-48)
(DE91-017455; SAND-91-1687C; CONF-910626-6) Avail: NTIS HC/MF A03

The use of ground-based lasers to launch small payloads but large total masses into low-Earth orbit may prove to be the most innovative and potentially economical approach for accomplishing this important mission. Of the several possible schemes for laser propulsion, two are examined: (1) ablative momentum transfer using pulsed lasers; and (2) heat exchanger thrusters in conjunction with CW lasers. For an entry-level payload of approximately 50 kg, it is found that the former yields payload-to-power ratios less than 0.5 kg/MW with a requirement for an average laser power of at least 100 MW, whereas the latter might yield 1 to 3 kg/MW with a laser power of several 10s of MW. One of the promising approaches that could yield a driver for such a system is the reactor-pumped laser FALCON, which scales to these power levels with the potential for long run times. DOE

**N91-32491#** Los Alamos National Lab., NM.
**SPONTANEOUS EMISSION FROM FREE ELECTRON LASERS**
M. J. Schmitt 1991 12 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-36)
(DE91-017820; LA-UR-91-2589; CONF-9107115-39) Avail: NTIS HC/MF A03

Characteristics of the fundamental and harmonic emission from free-electron lasers (FELs) are examined in the spontaneous emission (SE) regime. The radiation at both odd and even harmonic frequencies is treated for electron beams with finite emittance and energy spread. For wigglers with many wiggle periods, calculation of the SE by integrating an ensemble of electrons along their exact trajectories becomes exceedingly cumbersome. Therefore, a different technique is used in which the far-field radiation pattern of a single electron is manipulated in transform space to include the effects of emittance. The effects of energy spread can be included by weighted sum over the energy distribution. The program execution time for wigglers of arbitrary length is negligible. The transverse radiation patterns including the transverse frequency dependences, are given. How this radiation is modeled in FEL simulation codes is discussed. DOE

**N91-32492#** Los Alamos National Lab., NM.
**THE LOS ALAMOS PHOTOINJECTOR-DRIVEN FREE-ELECTRON LASER**
P. G. OShea 1991 7 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-36)
(DE91-017824; LA-UR-91-2538; CONF-9107115-40) Avail: NTIS HC/MF A02

The Los Alamos free-electron laser (FEL) facility has been modified by the replacement of the thermionic electron gun and bunchers with a 1300 MHz RF photoinjector. Two more accelerator tanks have been added to increase the beam energy to 40 MeV. Preliminary studies at 15 MeV have demonstrated excellent beam quality with a normalized emittance of 40 pi mm-mrad. The beam quality is now sufficient to allow harmonic lasing in the visible. We have recently begun lasing at a wavelength near 3 microns. DOE

**N91-32493#** Los Alamos National Lab., NM.
**SIMULATION OF APLE PHOTOINJECTOR**
Harunori Takeda and B. D. McVey 1991 19 p Presented at the 13th International Free-Electron Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 1991
(Contract W-7405-eng-36)
(DE91-018048; LA-UR-91-2754; CONF-9108118-2) Avail: NTIS HC/MF A03

This paper presents the PARMELA simulations of the photoinjector for the Average Power Laser Equipment (APLE). We modified the PARMELA code to include the misalignment of magnetic field coils. The effects on beam emittance from the combination of the misaligned coil and correction REC magnets are studied. The normalized four times rms emittance is calculated as 80 pi mm-mr at the end of photoinjector with the correction magnets. DOE

**N91-32306#** ANT Nachrichtentechnik, Backnang (Germany, F.R.).
**SELECTION STRATEGY AND RELIABILITY ASSESSMENT FOR SILEX-COMMUNICATION LASER DIODES**
Roland Loeffler and Bodo Menke *In* ESA, ESA Electronic Components Conference Mar. 1991 p 107-112 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32307#** Centre National d'Etudes des Telecommunications, Lannion (France).
**DIRECT INFLUENCE OF CHIP DESIGN AND MATERIAL COMPOSITION ON GaAs/GaAlAs LASER DIODES RELIABILITY**
P. Devoldere, M. Robinet, B. Bauduin, and D. Riviere *In* ESA, ESA Electronic Components Conference Mar. 1991 p 113-118 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32316#** University Coll., Cork (Ireland). National Microelectronics Research Center.
**ASSESSMENT OF p-METALLISATIONS FOR HIGH POWER GaAs LASER DIODES**
Cormac S. Long and W. M. Kelly *In* ESA, ESA Electronic Components Conference Mar. 1991 p 171-172 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32318#** Plessey Research (Caswell) Ltd., Towcester (England).
**HIGH PERFORMANCE PACKAGES FOR SPACE APPLICATIONS: REVIEW OF PACKAGING AND ASSEMBLY METHODS FOR LONG WAVELENGTH LASER DIODES**
C. E. Lindsay *In* ESA, ESA Electronic Components Conference Mar. 1991 p 175-178 Sponsored by ESA (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32645*#** Air Force Geophysics Lab., Hanscom AFB, MA. Atmospheric Sciences Div.
**A SURVEY OF LASER LIGHTNING ROD TECHNIQUES**
Arnold A. Barnes, Jr. and Robert O. Berthel *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 6 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 20E

**N91-32680*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**COMPUTER MODELING OF PULSED CO2 LASERS FOR LIDAR APPLICATIONS**
Gary D. Spiers, Martin E. Smithers, and Rom Murty (Alabama A & M Univ., Normal.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 61-62 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 20E

# 37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

**N91-32494** Carnegie-Mellon Univ., Pittsburgh, PA.
**A UNIFIED MOTION PLANNING APPROACH FOR REDUNDANT AND NONREDUNDANT MANIPULATORS WITH ACTUATOR CONSTRAINTS Ph.D. Thesis**
Ching Luan Chung 1990 120 p
Avail: Univ. Microfilms Order No. DA9117505

The term trajectory planning has been used to refer to the process of determining the time history of joint trajectory of each joint variable corresponding to a specified trajectory of the end effector. The trajectory planning problem was solved as a purely kinematic problem. The drawback is that there is no guarantee that the actuators can deliver the effort necessary to track the planned trajectory. To overcome this limitation, a motion planning approach which addresses the kinematics, dynamics, and feedback control of a manipulator in a unified framework was developed. Actuator constraints are taken into account explicitly and a-priori in the synthesis of the feedback control law. Therefore the result of applying the motion planning approach described is not only the determination of the entire set of joint trajectories but also a complete specification of the feedback control strategy which would yield these joint trajectories without violating actuator constraints. The effectiveness of the unified motion planning approach is demonstrated on two problems which are of practical interest in manipulator robotics. Dissert. Abstr.

**N91-32495** Arizona State Univ., Tempe.
**DYNAMICS MODELING AND CONTROL OF A FLEXIBLE ROBOT ARM Ph.D. Thesis**
Chung Feng Jeffrey Kuo 1990 216 p
Avail: Univ. Microfilms Order No. DA9116758

More productive and efficient robot arms are being considered for future industrial and space applications. Some topics are discussed in the modeling and control of a one link flexible robot arm. When a flexible robot arm is rotated by a motor with an axis through the arm's fixed end, transverse vibration problem is a critical issue. The motor torque should be controlled to enable the arm's end effector to follow a specified trajectory. After arriving at a specified point, the robot arm should be able to proceed to the following step of motion without any residual vibration. A flexible robot arm with end effector is modeled as a beam with an end point mass. A derivation of the dynamic equations using both the variational and Newtonian approaches is presented. Based on extension of the classical root locus method for an infinite

dimensional flexible robot arm system, a feedback control system, which incorporates three suggested lower order controllers, is designed. Although these controller designs are based on a linear model of the flexible robot arm, the same design techniques were implemented on a nonlinear model. These design techniques may be extended to other distributed parameter systems.

Dissert. Abstr.

**N91-32496#** Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques, Brussels (Belgium). Section Construction Metallique.

**HIGH SPEED WELDING USED IN BUILDING METALLIC STRUCTURES [APPLICATION DE SOUDAGE A GRANDE VITESSE EN CONSTRUCTION METALLIQUE]**

M. Flahaux, M. Hubert (Ministere de l'Equipment et des Transports, Brussels, Belgium ), and J. Janss Dec. 1990 53 p In FRENCH Sponsored by Inst. pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture

(CRIF-MT-180; ETN-91-99745) Avail: NTIS HC/MF A04

High speed welding up to a meter a minute is used to make steel beams meeting AE 355 D quality standards. Submerged twin arc welding systems give satisfactory results in terms or appearance, compactness, and strength. An oxyacetylene system is not recommended if a preheating or postheating treatment is called for. Post heating by means of an electric arc produces unacceptable appearance. This appearance problem is eliminated in the case of preheating with an electric arc. This preheating on, three out of four cases is not able to give the welded area the hardness needed to meet the standards imposed by the ministry of public works. ESA

**N91-32497*#** Auburn Univ., AL. Materials Engineering Program.

**A STUDY OF FRACTURE MECHANISMS IN ATD ROLLER BEARING Final Report, 6 Jun. 1989 - 5 Sep. 1990**

Ralph H. Zee 1990 58 p

(Contract NAS8-38083)

(NASA-CR-184200; NAS 1.26:184200) Avail: NTIS HC/MF A04 CSCL 13I

The purpose was to investigate how microstructures, especially anisotropy, affects internal stresses and the overall mechanical response of bearings. Samples with the stress axis along the aligned carbide direction possessed high modulus values compared to those with their axis perpendicular to the carbide stringers. The difference in the modulus was found to be more than a factor of two. A series of experiments was conducted on rolled samples to further investigate this effect; the two sets of results were consistent with each other. The degree of anisotropy of the microstructure in terms of the carbide and matrix orientations was determined using x-ray diffraction. The stress state determination was conducted using neutron diffraction. It was found that there was little variation in the distribution of the internal stresses amongst different samples, indicating that small changes in the processing and geometrical conditions did not result in significant variations in the internal stress. A nominal tensile hoop stress of 39 ksi was obtained for the inner raceway. Furthermore, during the course of the investigation, it was apparent that there was a need to determine the stress state induced by the shrink fitting process. Therefore, a series of experiments was conducted using strain gages to identify the stress distribution in a shrink fitting process in three different types of geometries. Correlations were obtained to estimate the highest stress values in the outer and inner groove geometry. A finite element program based on the ANSYS system was developed to compute the stress distribution in the inner raceway geometry. This analysis indicates that the highest tensile stress in the system occurs at the ID of the ring with a stress value of over 5 times that of the applied radial stress. Results from all these facets were correlated with one another. It appears that the material does not fail as a result of any one single factor, but results from a combination of the various factors investigated. Author

**N91-32498*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**TWO FAULT TOLERANT TOGGLE-HOOK RELEASE Patent**

Thomas Joseph Graves, inventor (to NASA) and Christopher William Brown, inventor (to NASA) 10 Sep. 1991 12 p Filed 25 Oct. 1990 Supersedes N91-13723 (29 - 5, p 670)

(NASA-Case-MSC-21671-1; US-Patent-5,046,395; US-Patent-Appl-SN-603337; US-Patent-Class-89-1.14; US-Patent-Class-89-1.57; US-Patent-Class-102-378; US-Patent-Class-294-82.26; Int-Patent-Class-B64D-1/12) Avail: US Patent and Trademark Office CSCL 13I

A coupling device is disclosed which is mechanically two fault tolerant for release. The device comprises a fastener plate and fastener body, each of which is attachable to a different one of a pair of structures to be joined. The fastener plate and body are coupled by an elongate toggle mounted at one end in a socket on the fastener plate for universal pivotal movement thereon. The other end of the toggle is received in an opening in the fastener body and adapted for limited pivotal movement therein. The toggle is adapted to be restrained by three latch hooks arranged in symmetrical equiangular spacing about the axis of the toggle, each hook being mounted on the fastener body for pivotal movement between an unlatching non-contact position with respect to the toggle and a latching position in engagement with a latching surface of the toggle. The device includes releasable lock means for locking each latch hook in its latching position whereby the toggle couples the fastener plate to the fastener body and means for releasing the lock means to unlock each said latch hook from the latch position whereby the unlocking of at least one of the latch hooks from its latching position results in the decoupling of the fastener plate from the fastener body.

Official Gazette of the U.S. Patent and Trademark Office

**N91-32499#** Bureau of Mines, Washington, DC.

**FLYWHEEL-POWERED SHUTTLE CAR**

J. R. Bartels, W. D. Mayercheck, and J. A. Hummer 1991 43 p

(PB91-200543; BUMINES-RI-9329; LC-90-2346) Avail: NTIS HC/MF A03 CSCL 13F

The development, system-by-system evaluation, and preliminary surface testing of a flywheel powered shuttle car is described. The use of a self-contained flywheel power source has the potential to eliminate the numerous safety and routing problems associated with tethered mobile equipment. An alternative to conventional power cable systems was developed consisting of the world's first seven rotor stacked flywheel system capable of storing 6 kW h of energy at 16,700 rpm. Numerous interdependent systems were necessary for successful interfacing with a conventional shuttle car. Each system was evaluated and tested individually. Finally, the entire shuttle car was surface tested. The tests indicated that the flywheel energy system can function and operate a shuttle car. The economics of the system and the design of required support systems were not addressed in the project. Author

**N91-32500#** Allied-Signal Aerospace Co., Kansas City, MO.

**NUMERICAL SIMULATION OF A LASER WELDING PROCESS**

M. Schrank Apr. 1991 17 p Presented at the ABAQUS User's Meeting, London, England, 11-13 Sep. 1991

(Contract DE-AC04-76DP-00613)

(DE91-016454; KCP-613-4560; CONF-9109236-1) Avail: NTIS HC/MF A03

Finite element methods are used to model a laser welding process applied to a stainless steel disk. Both 2-D and 3-D analyses are conducted in an overall effort to minimize distortions caused by the process. Analytical results compare reasonably well with experimental data. Symmetric application of welds to both the top and bottom surfaces of the disk is investigated and found to be an effective means of significantly reducing distortions. DOE

**N91-32501#** Lawrence Livermore National Lab., CA.

**APPLICATION OF TELEROBOTIC CONTROL TO REMOTE PROCESSING OF NUCLEAR MATERIAL**

R. D. Merrill, E. L. Grasz, C. J. Herget, D. T. Gavel, R. B. Addis,

and G. A. DeMinico Jul. 1991 26 p Presented at the 4th World Conference on Robotics Research, Pittsburgh, PA, 17-19 Sep. 1991
(Contract W-7405-eng-48)
(DE91-016562; UCRL-JC-106849; CONF-9109233-1) Avail: NTIS HC/MF A03

In processing radioactive material there are certain steps which have customarily required operators working at glove box enclosures. This can subject the operators to low level radiation dosages and the risk of accidental contamination, as well as generate significant radioactive waste to accommodate the human interaction. An automated system is being developed to replace the operator at the glove box and thus remove the human from these risks, and minimize waste. Although most of the processing can be automated with very little human operator interaction, there are some tasks where intelligent intervention is necessary to adapt to unexpected circumstances and events. These activities will require that the operator be able to interact with the process using a remote manipulator in a manner as natural as if the operator were actually in the work cell. This robot-based remote manipulation system, or telerobot, must provide the operator with an effective means of controlling the robot arm, gripper and tools. This paper describes the effort in progress in Lawrence Livermore National Laboratory to achieve this capability. DOE

**N91-32502#** Lawrence Livermore National Lab., CA.
**ROBOT DEVELOPMENT FOR NUCLEAR MATERIAL PROCESSING**
L. R. Pedrotti, G. A. Armantrout, D. C. Allen, and R. H. Sievers, Sr. Jul. 1991 9 p Presented at the 4th World Conference on Robotics Research, Pittsburgh, PA, 17-19 Sep. 1991
(Contract W-7405-eng-48)
(DE91-016567; UCRL-JC-106853; CONF-9109233-2) Avail: NTIS HC/MF A02

The Department of Energy is seeking to modernize its special nuclear material (SNM) production facilities and concurrently reduce radiation exposures, process, and incidental radioactive waste generated. As part of this program, the Lawrence Livermore National Laboratory (LLNL) lead team is developing and adapting generic and specific applications of commercial robotic technologies to SNM pyrochemical processing and other operations. A working gantry robot within a sealed processing glove box and a telerobot control test bed are manifestations of this effort. This paper describes the development challenges and progress in adapting processing, robotic, and nuclear safety technologies to the application. DOE

**N91-32503#** Lawrence Livermore National Lab., CA.
**INHERENTLY SAFE NUCLEAR-DRIVEN INTERNAL COMBUSTION ENGINES**
P. Alesso, Tze-Show Chow, R. Condit, J. Heidrich, J. Pettibone, and R. Streit 14 Jun. 1991 5 p Presented at the 6th International Conference on Emerging Nuclear Energy Systems, Monterey, CA, 16-21 Jun. 1991
(Contract W-7405-eng-48)
(DE91-016568; UCRL-JC-107417; CONF-910626-5) Avail: NTIS HC/MF A01

A family of nuclear driven engines is described in which nuclear energy released by fissioning of uranium or plutonium in a prompt critical assembly is used to heat a working gas. Engine performance is modeled using a code that calculates hydrodynamics, fission energy production, and neutron transport self-consistently. Results are given demonstrating a large negative temperature coefficient that produces self-shutoff of energy production. Reduced fission product inventory and the self-shutoff provide inherent nuclear safety. It is expected that nuclear engine reactor units could be scaled from 100 MW on up. DOE

**N91-32504#** Lawrence Livermore National Lab., CA.
**HOT GAS TEST RESULTS OF A MINIATURE FREE-PISTON PRESSURIZATION PUMP DRIVEN BY HYDRAZINE DECOMPOSITION PRODUCTS**
J. C. Maybee, P. J. Giesy, and A. Ekshtut 3 Jun. 1991 32 p Previously announced in IAA as A91-44328
(Contract W-7405-eng-48)
(DE91-017072; UCRL-CR-107473) Avail: NTIS HC/MF A03

A hot gas free-piston pressurization pump has been successfully demonstrated with hot gas. The pump is the key component of a lightweight rocket propulsion system which utilizes hydrazine decomposition products from a gas generator to pump hydrazine fuel from low pressure propellant tanks to a high pressure fuel manifold. The pump's design is described and test results are presented and analyzed for recent hot and cold gas tests. The significant parameters measured during testing include forward and refill stroke times, valve pressurization and exhaust times, effective boost ratio, volumetric output, piston ring leakage, and thermal responses of the liquid and gas sides of the pump. DOE

**N91-32505#** Argonne National Lab., IL.
**TRIBOLOGICAL BEHAVIOR OF SILVER FILMS PREPARED ON CERAMIC SURFACES BY ION-BEAM-ASSISTED DEPOSITION**
A. Erdemir, R. A. Erck, O. O. Ajayi, J. H. Hsieh, C. C. Cheng, and F. A. Nichols 1991 30 p Presented at the 5th International Conference on Surface Modification Technologies, Birmingham, England, 2-4 Sep. 1991
(Contract W-31-109-eng-38)
(DE91-017306; ANL/CP-72519; CONF-9109243-1) Avail: NTIS HC/MF A03

This study was undertaken to achieve low friction and low wear on ceramic materials by using adherent silver films prepared by ion beam assisted deposition (IBAD). In this deposition technique, low energy ions are used to bombard the substrates and films before and during deposition to achieve better film-to-substrate adhesion, which is essential for improved tribological behavior. Cross sectional transmission electron microscopy (XTEM) was used to investigate the grain morphology and the nucleation and growth characteristics of IBAD-silver films at film-substrate interfaces. A ball-on-disk tribometer was used to evaluate the friction and wear properties of the silver coated ceramics. The XTEM studies indicated that the films exhibited an equiaxed grain structure with grain sizes ranging from 5 to 10 nm. Gaps and/or discontinuity were not detected at the interfaces, indicating that the silver films bond intimately to the alumina substrates. Tribological test results indicated that the wear of disks coated with IBAD silver was unmeasurably low; wear of alumina balls was by factors of 10 to 50 lower than the wear of balls sliding against uncoated disks. The friction coefficient was 1/2 to 1/3 that of sliding pairs without IBAD silver films. DOE

**N91-32506#** Argonne National Lab., IL.
**EFFECTS OF OXYGEN ENRICHMENT AND FUEL EMULSIFICATION ON DIESEL ENGINE PERFORMANCE AND EMISSIONS**
R. R. Sekar, W. W. Marr, R. L. Cole, T. J. Marciniak, and J. E. Schaus (AutoResearch Labs., Inc., Chicago, IL.) 1991 8 p Presented at the American Society of Mechanical Engineers (ASME) International Combustion Engine Technical Conference, Muskegon, MI, 30 Sep. - 2 Oct. 1991
(Contract W-31-109-eng-38)
(DE91-016520; ANL/CP-73728; CONF-910927-1) Avail: NTIS HC/MF A02

Tests on a single cylinder, direct injection diesel engine coupled to an oxygen-enriching membrane system were performed. In the effects of injection timing were investigated. An oxygen-enriching membrane was used to supply combustion air. Use of bottled oxygen in any real diesel engine application would be a safety hazard, so bottled oxygen is unlikely to be used in commercial engine applications. For this reason, it is important to demonstrate an engine system with an on-line oxygen-enriching device. Tests were conducted with no. 2 and 4 diesel fuels. The data indicated that NO(x) emissions increase when the oxygen level is increased from 21 to 27 pct., but retarding the injection timing by 11 degrees crank angle significantly reduced the NO(x) emissions. The effect on NO(x) reduction of retarding the injection timing is greater at higher oxygen levels. The water emulsification of the fuels also reduced NO(x) emissions significantly. It was shown that

oxygen-enriched combustion air reduced particulate emissions, smoke, and ignition delay. The effect on ignition delay resulted in a favorable NO(x) vs. fuel consumption trade-off when the injection timing changed. The collective data lead to the conclusion that an optimum set of the major operating variables, including (1) oxygen level in the combustion air, (2) water level in the fuel, and (3) injection timing, could lead to a diesel engine system that has significantly lower particulates, smoke, and NO(x) emissions, without loss of efficiency; the ability to use lower cost heavy liquid fuels; and the potential for increasing the power output by as much as 50 pct. with only an increase of 15 pct. in peak cylinder pressure. DOE

**N91-32507** George Washington Univ., Washington, DC.
**A REFERENCE MODEL DYNAMICS-CMAC ALGORITHM FOR SIMULATION AND CONTROL OF ROBOTIC MANIPULATORS Ph.D. Thesis**
Azim Eskandarian 1991 287 p
Avail: Univ. Microfilms Order No. DA9123064

Dynamics modeling is important for the design, analysis, simulation, and control of robotic and other computer controlled mechanical systems. The complete dynamic modeling of such systems involves the computationally intensive solution of a set of nonlinear, coupled, and complicated differential equations. Learning algorithms and neural networks simulation models have shown great potential in learning and representing the input-output relationships of complex dynamic systems. These algorithms due to their ability to represent complex functions by means of a repetitive training process, in addition to their ability to operate in real time due to their simplicity in computation and strong dependence on tabulation, lend themselves well to the manipulator dynamic modeling problem. The application of a learning algorithm to dynamics modeling of complex robotic systems is studied. The Cerebellar Model Arithmetic Computer (CMAC) is used. An advanced hybrid implementation of CMAC is proposed to allow use of the model for either simulation or control of robotic manipulators. Methods for off-line training of the networks in simulation are developed and evaluated. The simulation results have shown successful implementation of the algorithm. An alternate method of on-line training using a robot manipulator is proposed for further experimental verification. Dissert. Abstr.

**N91-32508*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**NOZZLE FABRICATION TECHNIQUE Patent**
Dennis L. Wells, inventor (to NASA) 24 Sep. 1991 9 p Filed 26 May 1989 Division of US-Patent-Appl-SN-176587, filed 1 Apr. 1988
(NASA-Case-MSC-21299-2; US-Patent-5,051,559; US-Patent-Appl-SN-358029; US-Patent-Appl-SN-176587; US-Patent-Class-219-121.72; US-Patent-Class-29-558; US-Patent-Class-219-69.12; Int-Patent-Class-B23K-26/00) Avail: US Patent and Trademark Office CSCL 13H

A block of electrically conductive material which is to be formed into a body with internal and/or external surfaces that approximate hyperboloids of one sheet is placed so that its axis is set at a predetermined skew angle with relation to a traveling EDM electrode wire. The electrode wire is then moved into cutting proximity of the body wire. Thereafter, by revolving the body about its own axis, the external and/or internal surfaces of the body will be cut into an approximate hyperbolic surface of revolution depending upon whether the body is positioned with the cutting wire outside of the body or in a previously formed longitudinal passage in the body. As an alternative technique, elongated channels can also be cut into the wall of the body by successively orienting the body to a selected number of angular positions, with the electrode wire being either outside of the body or in a previously formed passage in the body. At each of these angular positions, the electrode wire is moved orthogonally with respect to the axis of the wire, while both the body axis skew angle and the rotational position about that axis is controlled by cutting a channel or groove in the body to relieve stresses in the body material or to convey a coolant fluid.
Official Gazette of the U.S. Patent and Trademark Office

**N91-32509*#** National Aeronautics and Space Administration. Pasadena Office, CA.
**TELEROBOT CONTROL SYSTEM Patent Application**
Paul G. Backes, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 9 May 1991 29 p
(Contract NAS7-918)
(NASA-Case-NPO-18116-1-CU; NAS 1.71:NPO-18116-1-CU; US-Patent-Appl-SN-699299) Avail: NTIS HC/MF A03 CSCL 13I

This invention relates to an operator interface for controlling a telerobot to perform tasks in a poorly modeled environment and/or within unplanned scenarios. The telerobot control system includes a remote robot manipulator linked to an operator interface. The operator interface includes a setup terminal, simulation terminal, and execution terminal for the control of the the graphics simulator and local robot actuator as well as the remote robot actuator. These terminals may be combined in a single terminal. Complex tasks are developed from sequential combinations of parameterized task primitives and recorded teleoperations, and are tested by execution on a graphics simulator and/or local robot actuator, together with adjustable time delays. The novel features of this invention include the shared and supervisory control of the remote robot manipulator via operator interface by pretested complex tasks sequences based on sequences of parameterized task primitives combined with further teleoperation and run-time binding of parameters based on task context. NASA

**N91-32510*#** National Aeronautics and Space Administration. Pasadena Office, CA.
**A GENERALIZED COMPLIANT MOTION PRIMITIVE Patent Application**
Paul G. Backes, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 9 Aug. 1991 53 p
(Contract NAS7-918)
(NASA-Case-NPO-18134-1-CU; NAS 1.71:NPO-18134-1-CU; US-Patent-Appl-SN-744118) Avail: NTIS HC/MF A04 CSCL 13I

This invention relates to a general primitive for controlling a telerobot with a set of input parameters. The primitive includes a trajectory generator; a teleoperation sensor; a joint limit generator; a force setpoint generator; a dither function generator, which produces telerobot motion inputs in a common coordinate frame for simultaneous combination in sensor summers. Virtual return spring motion input is provided by a restoration spring subsystem. The novel features of this invention include use of a single general motion primitive at a remote site to permit the shared and supervisory control of the robot manipulator to perform tasks via a remotely transferred input parameter set. NASA

**N91-32511*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**LINEAR MASS ACTUATOR Patent Application**
Sidney E. Holloway, III, inventor (to NASA), Edward A. Crossley, inventor (to NASA), Irby W. Jones, inventor (to NASA), James B. Miller, inventor (to NASA), C. Calvin Davis, inventor (to NASA), Vaughn D. Behun, inventor (to NASA), and Lewis R. Goodrich, Sr., inventor (to NASA) (PRC Kentron, Inc., Hampton, VA.) 22 Jul. 1991 20 p
(NASA-Case-LAR-14352-1; NAS 1.71:LAR-14352-1; US-Patent-Appl-SN-735149) Avail: NTIS HC/MF A03 CSCL 20K

A linear mass actuator includes an upper housing and a lower housing connectable to each other and having a central passageway passing axially therethrough a mass linearly movable in the central passageway. Rollers mounted in the upper and lower housings and being in frictional engagement with the mass, translates the mass linearly in the central passageway and drive motors operatively coupled to the roller means, for rotating the rollers and thus driving the mass axially in the central passageway. NASA

**N91-32512*#** North Carolina Univ., Charlotte. Dept. of Mechanical Engineering and Engineering Science.
**A MAGNETO-SENSITIVE SKIN FOR ROBOTS IN SPACE Final Report, period ending 14 Jul. 1991**
D. S. Chauhan and P. H. DeHoff 1991 10 p
(Grant NAG5-1053)
(NASA-CR-188956; NAS 1.26:188956; ME/ES-TR-91-4) Avail: NTIS HC/MF A02 CSCL 13I

The development of a robot arm proximity sensing skin that can sense intruding objects is described. The purpose of the sensor would be to prevent the robot from colliding with objects in space including human beings. Eventually a tri-mode system in envisioned including proximity, tactile, and thermal. To date the primary emphasis was on the proximity sensor which evolved from one based on magneto-inductive principles to the current design which is based on a capacitive-reflector system. The capacitive sensing element, backed by a reflector driven at the same voltage and in phase with the sensor, is used to reflect field lines away from the grounded robot toward the intruding object. This results in an increased sensing range of up to 12 in. with the reflector on compared with only 1 in. with it off. It is believed that this design advances the state-of-the-art in capacitive sensor performance.
Author

**N91-32513#** Oak Ridge Y-12 Plant, TN.
**GAS TUNGSTEN ARC ADAPTIVE WELDING**
B. Fleischer and J. R. Younkin 23 Jul. 1991 8 p
(Contract DE-AC05-84OS-21400)
(DE91-017848; Y/DV-1100) Avail: NTIS HC/MF A02

A system suitable for real time adaptive control of the multipass weld has been developed. Electrode position, weld current and wire-feed speed are controlled to accommodate variations encountered as a consequence of the allowable dimensional machining and assembly tolerances. Control of the parameters is based on computer analysis of video images obtained from a miniature video camera placed coaxial with the welding electrode. Nondestructive examination of a weld test ring made under adaptive feedback control has confirmed that the test weld meets the quality requirements applied to the weld.
DOE

**N91-32514*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**BIDIRECTIONAL DRIVE AND BRAKE MECHANISM Patent**
Scott A. Swan, inventor (to NASA) 22 Oct. 1991 19 p Filed 23 May 1990 Supersedes N90-26342 (28 - 20, p 2872)
(NASA-Case-MSC-21540-1; US-Patent-5,058,506;
US-Patent-Appl-SN-527508; US-Patent-Class-105-87;
US-Patent-Class-105-141; US-Patent-Class-105-142;
US-Patent-Class-105-124; US-Patent-Class-188-24.11;
Int-Patent-Class-B61D-15/08) Avail: US Patent and Trademark Office CSCL 13I

A space transport vehicle is disclosed as including a body which is arranged to be movably mounted on an elongated guide member disposed in outer space and driven therealong. A drive wheel is mounted on a drive shaft and arranged to be positioned in rolling engagement with the elongated guide carrying the vehicle. A brake member is arranged on the drive shaft for movement into and out of engagement with an adjacent surface of the drive wheel. An actuator is mounted on the body to be manually moved back and forth between spaced positions in an arc of movement. A ratchet-and-pawl mechanism is arranged to operate upon movements of the actuator in one direction between first and second positions for coupling the actuator to the drive wheel to incrementally rotate the wheel in one rotational direction and to operate upon movements of the actuator in the opposite direction for uncoupling the actuator from the wheel. The brake member is threadedly coupled to the drive shaft in order that the brake member will be operated only when the actuator is moved on beyond its first and second positions for shifting the brake member along the drive shaft and into frictional engagement with the adjacent surface on the drive wheel.
Official Gazette of the U.S. Patent and Trademark Office

**N91-32632*#** CESI, Milan (Italy). High Voltage Div.
**EVALUATION OF THE DAMAGES CAUSED BY LIGHTNING CURRENT FLOWING THROUGH BEARINGS**
O. Celi, A. Pigini, and E. Garbagnati (Ente Nazionale per l'Energia Elettrica, Milan, Italy ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 13K

# 38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

**N91-32515*#** National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.
**GAMMA RAY COLLIMATOR Patent Application**
Edgar J. Casanova, inventor (to NASA) (Sverdrup Technology, Inc., Bay Saint Louis, MS.) 6 Aug. 1991 18 p
(NASA-Case-SSC-00013-1; NAS 1.71:SSC-00013-1;
US-Patent-Appl-SN-740675) Avail: NTIS HC/MF A03 CSCL 14D

A gamma ray collimator including a housing having first and second sections is disclosed. The first section encloses a first section of depleted uranium which is disposed for receiving and supporting a radiation emitting component such as cobalt 60. The second section encloses a depleted uranium member which is provided with a conical cut out focusing portion disposed in communication with the radiation emitting element for focusing the emitted radiation to the target.
NASA

**N91-32323#** Texas Instruments France, Velizy-Villacoublay. Regional Technology Center.
**AN ADVANCED TESTABILITY CONCEPT FOR SPACE APPLICATIONS**
Odile Grimberg *In* ESA, ESA Electronic Components Conference Mar. 1991 p 201-203 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32365#** Selenia Spazio S.p.A., Rome (Italy).
**RESULTS AND CONSIDERATIONS ON FAILURE INVESTIGATIONS OF COMPONENTS USED FOR SPACE EQUIPMENT**
G. Tommaso *In* ESA, ESA Electronic Components Conference Mar. 1991 p 475-480 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32370#** Components Technology Inst., Inc., Huntsville, AL.
**THE HISTORY OF SPACE QUALITY EEE PARTS IN THE UNITED STATES**
Leon Hamiter *In* ESA, ESA Electronic Components Conference Mar. 1991 p 503-506 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32378#** IGG Component Technology Ltd., Portsmouth (England).
**THE MERITS OF AN INDEPENDENT PRE-CAP INSPECTION**
J. A. Jones *In* ESA, ESA Electronic Components Conference Mar. 1991 p 549-554 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32383#** Thomson-CSF, Orsay (France).
**EQML: A CHANCE FOR EUROPE**
P. Cuny and M. Barre (MATRA Espace, Paris-Velizy, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 575-577 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32384#** Texas Instruments France, Villeneuve-Loubet. Quality Dept.
**SPACE MANUFACTURING QUALITY THROUGH STATISTICAL PROCESS CONTROL: AN APPLICATION AT TEXAS INSTRUMENTS FRANCE, A SPACE SEMICONDUCTORS PRODUCTION LINE**
Jean-Paul Andrisi and Frederic Artuphel *In* ESA, ESA Electronic Components Conference Mar. 1991 p 579-585 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32385#** Thomson-CSF, Sainte Egreve (France).
**TOTAL QUALITY MANAGEMENT: WHAT ARE THE FACTS BEHIND THE CONCEPTS?**
J. Blanchart *In* ESA, ESA Electronic Components Conference Mar. 1991 p 587-588 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32389#** GEC-Plessey Semiconductors, Lincoln (England).
**TECHNOLOGY APPROVAL USING CAPABILITY INDICES**
W. J. Anderson *In* ESA, ESA Electronic Components Conference Mar. 1991 p 607-610 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

# 39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

**N91-32516** Brown Univ., Providence, RI.
**ANALYTICAL AND NUMERICAL STUDIES OF FRACTURE AND FATIGUE IN CERAMIC MATERIALS Ph.D. Thesis**
John Roger Brockenbrough 1990 211 p
Avail: Univ. Microfilms Order No. DA9101737

Constitutive and computational models were developed for two microstructural mechanisms which are active in many brittle materials; microcracking and martensitic transformation. A framework is presented for a general theory or cyclic compression fracture in brittle solids. Crack tip microcracking process zones have been proposed as a fracture mechanism in polycrystalline ceramics. An analysis is presented next which seeks to derive the ratio of dynamic to static fracture toughness values in microcracking brittle solids. The results are compared with experimental results of quasi-static and dynamic fracture initiation toughness for polycrystalline ceramics. At high temperatures, a theory for creep by interfacial flaw growth in ceramics and ceramic composites is presented based on a model of a deteriorating elastic solid. The predicted dependence of elastic creep strain rate on the far field stress, the progression of damage and the consequent reduction in elastic moduli, overall creep ductility, and implications pertaining to microstructural and temperature effects on creep are found to be in accord with a wide variety of experimental observations for ceramic and ceramic composites.
Dissert. Abstr.

**N91-32517** Stanford Univ., CA.
**FRACTURE CHARACTERIZATION FOR THERMOINELASTICITY Ph.D. Thesis**
David Anthony Wagner 1990 162 p
Avail: Univ. Microfilms Order No. DA9102368

The path domain independent integral S was developed and verified that is exactly the energy release rate for an extending crack within a thermoinelastic material response region. Emanating from thermoinelastic continuum mechanics and Noether's theorem from classical field theory, the S integral defines the force acting on an extending crack and represents a conservation law for a crack free body. Limited physical experiments and computational studies verify the S integral for uncoupled thermoinelasticity. S offers a parameter to improve the understanding of the strength and reliability of materials subjected to thermomechanical loadings. The theoretical development produces the S path domain independent integral for two quasi-static cases: uncoupled thermoinelasticity and fully coupled thermoinelasticity. Proofs demonstrate the path domain independence and the total energy release rate aspects of the S integral. A limited experimental program and an associated computational study verifies that the S integral characterizes fracture for uncoupled thermoinelasticity. Experiments on a crack free Al sheet and finite element results from a simple dogbone specimen verify the S conservation law.
Dissert. Abstr.

**N91-32518#** Army Armament Research, Development and Engineering Center, Watervliet, NY.
**LOAD-LINE DISPLACEMENTS FOR THREE-POINT BEND J TESTS USING BOTTOM SURFACE DISPLACEMENTS Final Report**
J. H. Underwood and M. D. Witherell Oct. 1990 14 p
(AD-A229634; ARCCB-MR-90029) Avail: NTIS HC/MF A03 CSCL 20/11

Finite element calculations show that elastic displacements along the bottom surface of a three-point bend specimen can be used to obtain a close approximation to the load-line displacement at the crack line. The use of load-line displacement for measuring crack growth by unloading compliance is discussed with application to a simplified test procedure for J-integral fracture toughness tests.
GRA

**N91-32519*#** Rensselaer Polytechnic Inst., Troy, NY. Dept. of Mechanical Engineering, Aeronautical Engineering, and Mechanics.
**NONLINEAR DYNAMIC ANALYSIS OF FLEXIBLE MULTIBODY SYSTEMS Final Report**
Olivier A. Bauchau and Nam Kook Kang Jul. 1991 119 p
(Grant NAG1-1018)
(NASA-CR-187597; NAS 1.26:187597) Avail: NTIS HC/MF A06 CSCL 20K

Two approaches are developed to analyze the dynamic behavior of flexible multibody systems. In the first approach each body is modeled with a modal methodology in a local non-inertial frame of reference, whereas in the second approach, each body is modeled with a finite element methodology in the inertial frame. In both cases, the interaction among the various elastic bodies is represented by constraint equations. The two approaches were compared for accuracy and efficiency: the first approach is preferable when the nonlinearities are not too strong but it becomes cumbersome and expensive to use when many modes must be used. The second approach is more general and easier to implement but could result in high computation costs for a large system. The constraints should be enforced in a time derivative fashion for better accuracy and stability.
Author

**N91-32520*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**COMPUTATIONAL SIMULATION OF HIGH TEMPERATURE METAL MATRIX COMPOSITE BEHAVIOR**
Pappu L. N. Murthy and Christos C. Chamis 1991 17 p
Presented at the Eighth International Conference on Composite Materials, Honolulu, HI, 15-19 Jul. 1991; sponsored by the Society

for the Advancement of Materials and Process Engineering
(NASA-TM-104378; E-6183; NAS 1.15:104378) Avail: NTIS HC/MF A01 CSCL 20K

Computational procedures are described to simulate the thermal and mechanical behavior of high temperature metal matrix composite (HT MMC) in the following four broad areas: (1) behavior of HT MMC from micromechanics to laminate; (2) HT MMC structural response for simple and complex structural components; (3) HT MMC microfracture; and (4) tailoring of HT MMC behavior for optimum specific performance. Representative results from each area are presented to illustrate the effectiveness of the computational simulation procedures. Relevant reports are referenced for extended discussion regarding the specific area.
Author

**N91-32521#** Acoustical Society of America, New York, NY.
**US TAG FOR ISO/TC108 MECHANICAL VIBRATION AND SHOCK: MINUTES OF THE ACCREDITED STANDARDS COMMITTEE ON MECHANICAL SHOCK AND VIBRATION, S2**
1 May 1991 146 p Presented at a Meeting held in Baltimore, MD, 1 May 1991
(AD-A239536; ASA-S2/222) Avail: NTIS HC/MF A07 CSCL 20/11

The proceedings of the committee meeting are presented. The meeting went as follows: Approval of the Minutes; Organization; Standards approved by ANSI in 1990/1991 and published (or being published) by ASA; Organizational matters and reports on working groups, including reports on letter ballots and international matters; International Organization for Standardization (ISO)-Technical Committee ISO/TC 108 on Mechanical Vibration and Shock-D. Muster, U.S. Technical Advisor General; IEC/SC50A Shock and Vibration Tests-I. Brockman Technical Advisor-D. Muster, U.S. Deputy Technical Advisor; Review of Standards more than five years in existence; New International Standards Available from ANSI; Documents from other organizations submitted to S2 for vote and/or comment; and Procedural Ballots. GRA

**N91-32522#** Ship Structure Committee, Washington, DC.
**UNCERTAINTIES IN STRESS ANALYSIS ON MARINE STRUCTURES Final Report**
E. Nikolaidis and P. Kaplan Apr. 1991 107 p Prepared in cooperation with Virginia Polytechnic Inst. and State Univ., Blacksburg Sponsored by Coast Guard, Washington, DC
(Contract DTCG23-88-R-20020)
(PB91-193441; SSC-363) Avail: NTIS HC/MF A06 CSCL 20K

A survey of the state of knowledge on uncertainties in stress analyses on marine structures is presented. Uncertainties are classified and methods for modeling them are presented. Modeling uncertainties and their effects on extreme design loads are emphasized. Uncertainties in the following steps of stress analysis are quantified and ranked in terms of relative importance: (1) description of loading environment; (2) evaluation of loads; (3) combination of loads; (4) structural analysis; and (5) fatigue. A 5 year research program is proposed for reducing uncertainties. This program consists of 14 tasks which have been prioritized in terms of expected benefits, risk, and cost. Author

**N91-32523*#** Akron Univ., OH. Dept. of Civil Engineering.
**FINITE ELEMENT IMPLEMENTATION OF STATE VARIABLE-BASED VISCOPLASTICITY MODELS Final Report**
I. Iskovitz, T. Y. P. Chang, and A. F. Saleeb Sep. 1991 41 p
(Grant NAG3-901)
(NASA-CR-187212; NAS 1.26:187212) Avail: NTIS HC/MF A03 CSCL 20K

The implementation of state variable-based viscoplasticity models is made in a general purpose finite element code for structural applications of metals deformed at elevated temperatures. Two constitutive models, Walker's and Robinson's models, are studied in conjunction with two implicit integration methods: the trapezoidal rule with Newton-Raphson iterations and an asymptotic integration algorithm. A comparison is made between the two integration methods, and the latter method appears to be computationally more appealing in terms of numerical accuracy and CPU time. However, in order to make the asymptotic algorithm robust, it is necessary to include a self adaptive scheme with subincremental step control and error checking of the Jacobian matrix at the integration points. Three examples are given to illustrate the numerical aspects of the integration methods tested.
Author

**N91-32524*#** Southwest Research Inst., San Antonio, TX.
**PROBABILISTIC STRUCTURES ANALYSIS METHODS (PSAM) FOR SELECT SPACE PROPULSION SYSTEM COMPONENTS Annual Report No. 2, Nov. 1986**
Sep. 1991 301 p
(Contract NAS3-24389)
(NASA-CR-187196; NAS 1.26:187196) Avail: NTIS HC/MF A14 CSCL 20K

The basic formulation for probabilistic finite element analysis is described and demonstrated on a few sample problems. This formulation is based on iterative perturbation that uses the factorized stiffness on the unperturbed system as the iteration preconditioner for obtaining the solution to the perturbed problem. This approach eliminates the need to compute, store and manipulate explicit partial derivatives of the element matrices and force vector, which not only reduces memory usage considerably, but also greatly simplifies the coding and validation tasks. All aspects for the proposed formulation were combined in a demonstration problem using a simplified model of a curved turbine blade discretized with 48 shell elements, and having random pressure and temperature fields with partial correlation, random uniform thickness, and random stiffness at the root. Author

**N91-32525** Rutgers - The State Univ., New Brunswick, NJ.
**MODELING OF A LARGE CLASS OF UNDAMPED FLEXIBLE STRUCTURES EXPERIENCING LARGE ANGULAR EXCURSIONS Ph.D. Thesis**
Christopher Dunn Smith 1991 259 p
Avail: Univ. Microfilms Order No. DA9125399

The analysis of an arbitrarily constrained, nonuniform beam in a non-Newtonian reference frame requires special attention to centrifugal and coriolis effects caused by the rotation. In addition to distributed displacement and velocity coordinates of each beam cross-section within the non-Newtonian frame, the angular velocity components of the reference frame itself are treated as coordinates to be determined, resulting in redundant coordinates. Such a formulation requires the imposition of an arbitrary constraint. The equations of motion are derived from the Hamilton's principle using Lagrange multipliers to preserve explicitly the constraint relationship. The resulting equations of motion are valid for large angular velocities and accelerations, but restricted by small flexible motion assumptions. Characteristics of the internal dynamics, including stiffening and softening effects, are examined, and shape and attitude control problems associated with this rudimentary spacecraft model are presented and discussed. In particular, a method is presented which allows to treat the non-linear equations of motion as time-varying linear equations. A numerical simulation of the response of an unconstrained beam subject to disturbance and control inputs verifies the analytically derived conclusions.
Dissert. Abstr.

**N91-32526*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**LANCZOS EIGENSOLUTION METHOD FOR HIGH-PERFORMANCE COMPUTERS**
Susan W. Bostic Sep. 1991 31 p Submitted for publication
(NASA-TM-104108; NAS 1.15:104108) Avail: NTIS HC/MF A03 CSCL 20K

The theory, computational analysis, and applications are presented of a Lanczos algorithm on high performance computers. The computationally intensive steps of the algorithm are identified as: the matrix factorization, the forward/backward equation solution, and the matrix vector multiples. These computational steps are optimized to exploit the vector and parallel capabilities of high performance computers. The savings in computational time from applying optimization techniques such as: variable band and sparse

data storage and access, loop unrolling, use of local memory, and compiler directives are presented. Two large scale structural analysis applications are described: the buckling of a composite blade stiffened panel with a cutout, and the vibration analysis of a high speed civil transport. The sequential computational time for the panel problem executed on a CONVEX computer of 181.6 seconds was decreased to 14.1 seconds with the optimized vector algorithm. The best computational time of 23 seconds for the transport problem with 17,000 degs of freedom was on the the Cray-YMP using an average of 3.63 processors. Author

**N91-32527*#** Analytical Services and Materials, Inc., Hampton, VA.
**SIMPLIFIED MICROMECHANICAL EQUATIONS FOR THERMAL RESIDUAL STRESS ANALYSIS OF COATED FIBER COMPOSITES**
R. A. Naik Sep. 1991 27 p
(Contract NAS1-18599)
(NASA-CR-187599; NAS 1.26:187599) Avail: NTIS HC/MF A03 CSCL 20K

The fabrication of metal matrix composites poses unique problems to the materials engineer. The large thermal expansion coefficient (CTE) mismatch between the fiber and matrix leads to high tensile residual stresses at the fiber/matrix (F/M) interface which could lead to premature matrix cracking during cooldown. Fiber coatings could be used to reduce thermal residual stresses. A simple closed form analysis, based on a three phase composite cylinder model, was developed to calculate thermal residual stresses in a fiber/interphase/matrix system. Parametric studies showed that the tensile thermal residual stresses at the F/M interface were very sensitive to the CTE and thickness of the interphase layer. The modulus of the layer had only a moderate effect on tensile residual stresses. For a silicon carbide titanium aluminide composite, the tangential stresses were 20 to 30 pct. larger than the axial stresses, over a wide range of interphase layer properties, indicating a tendency to form radial matrix cracks during cooldown. Guidelines for the selection of appropriate material properties of the fiber coating were also derived in order to minimize thermal residual stresses in the matrix during fabrication. Author

# 42 GEOSCIENCES (GENERAL)

No abstracts in this category.

# 43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

**N91-32528*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**INTERNATIONAL WORKSHOP ON STRATOSPHERIC AEROSOLS: MEASUREMENTS, PROPERTIES, AND EFFECTS**
Rudolf F. Pueschel, ed. Feb. 1991 76 p Workshop held at Moffett Field, CA, 27-30 Mar. 1990; sponsored in part by IAMAP Radiation Commission and the NASA Upper Atmosphere Research Program
(NASA-CP-3114; A-90293; NAS 1.55:3114) Avail: NTIS HC/MF A05 CSCL 04A

Following a mandate by the International Aerosol Climatology Program under the auspices of International Association of Meteorology and Atmospheric Physics International Radiation Commission, 45 scientists from five nations convened to discuss relevant issues associated with the measurement, properties, and effects of stratospheric aerosols. A summary is presented of the discussions on formation and evolution, transport and fate, effects on climate, role in heterogeneous chemistry, and validation of lidar and satellite remote sensing of stratospheric aerosols. Measurements are recommended of the natural (background) and the volcanically enhanced aerosol (sulfuric acid and silica particles), the exhaust of shuttle, civil aviation and supersonic aircraft operations (alumina, soot, and ice particles), and polar stratospheric clouds (ice, condensed nitric and hydrochloric acids). For individual titles, see N91-32529 through N91-32541.

**N91-32529*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**SCIENCE ISSUES** **c46**
*In its* International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 1-10 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

The present state is reviewed of understanding of the formation, transport, and final form of the stratospheric aerosols, focusing primarily on the sulfate aerosol (i.e., the Junge layer) rather than polar stratospheric clouds or transient aerosol events such as volcanic veils. Author

**N91-32530*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**MEASUREMENTS** **c46**
*In its* International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 11-25 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

To interpret the effects of aerosols and gases on the atmosphere, information on the vertical and horizontal distribution of aerosol particles, their size distributions and concentration of precursor gases is required. Measurements of aerosols and gases at frequent intervals and over vast areas of atmosphere generally involve remote sensing techniques. These techniques depend on the optical properties of the species studied. Optical properties can vary greatly with aerosol size and refractive index. Remote sensing instruments look at light scattering, extinction, depolarization, and reflection. The chemical composition, phase equilibria, surface properties, and photochemical behavior of stratospheric aerosols are not clearly understood or adequately measured by current technologies. Areas are listed which need technology development. Author

**N91-32531*#** Environmental Protection Agency, Research Triangle Park, NC.
**ANNULAR DENUDERS FOR USE IN GLOBAL CLIMATE AND STRATOSPHERIC MEASUREMENTS OF ACIDIC GASES AND PARTICLES Abstract Only** **c46**
Robert K. Stevens *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 41 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

Measurements of acidic and basic gases that coexist with fine particle (less than 2.5 micron) may be useful for determining the impact of these species on global climate changes and determining species that influence stratospheric ozone levels. Annular denuders are well suited for this purpose. A new concentric annular denuder system, consisting of a three channel denuder, a Teflon coated cyclone preseparator, and a multistage filter pack was developed, evaluated, and shown to provide reliable atmospheric measurements of SO2, HNO2, HNO3, NH3, SO4(=), NH4(+), NO3(-), and H(+). For example, the precision of the annular denuder for the ambient measurements of HNO3 and nitrates at concentrations between 0.1 to 3 microgram/cu m was + or - 12 and 16 pct., respectively. The 120 x 25 mm three channel denuder is encased in a stainless steel sheath and has annular spaces that are 1 mm wide. This design was shown to have nearly identical

capacity for removal of SO2 as conventional 210 x 25 mm single channel denuder configurations. The cyclone preseparator was designed and tested to have a D sub 50 cutoff diameter of 2.5 micron and minimal retention of HNO3. Author

**N91-32532*#** Kansas Univ., Lawrence. Dept. of Civil Engineering.
**ANNULAR DENUDER SYSTEMS: PRECISION AND APPLICABILITY TO STRATOSPHERIC SAMPLING c46**
Stephen J. Randtke and Dennis D. Lane *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 42-46 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

Annular denuder systems (ADS) are designed to sample both gases and particles from ambient air without cross interference. The ADS's were used to detect chemical gradients over rural forest canopies. Accurate and precise methods for the sampling and analysis of low concentrations of gaseous and particulate species over short sampling periods were developed. Typical analytical precision data for nitrate and sulfate are shown. Both sampling and analytical precision data for a 2 hour test using four collocated ADS's are presented. On this particular day, the overall precision for HNO3 was unusually poor. The overall precision for the major constituents of interest is generally about 3 to 5 percent for typical ambient concentrations. The ADS's could potentially be used to determine the concentrations of HNO3 and fine-particle nitrate in the stratosphere, and to simultaneously characterize the chemical composition of stratospheric aerosols. Assuming 50 mb pressure, a 2 hour sampling time, a 50 Lpm sampling rate, and a low blank value, an overal precision of about 15 percent should be possible for 1 ppbv of HNO3 or nitrate, which would include nitric-acid trihydrate (NAT); and pump-driven systems could accommodate more complex systems involving denuders and filter packs in sequence. Alternate coatings could possibly be developed to selectively sample species such as Cl2 and ClNO3. The ADS's might also be useful in laboratory studies of heterogeneous chemical reactions involving NAT aerosols. Author

**N91-32533*#** Desert Research Inst., Reno, NV.
**LABORATORY AND FIELD STUDIES OF STRATOSPHERIC AEROSOLS: PHASE CHANGES UNDER HIGH SUPERSATURATION Abstract Only c46**
John Hallet *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 47 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

It is well known that water in the form of isolated small droplets supercool as much as 40 C below their equilibrium melting point. Solutions similarly supercool (with respect to water) and supersaturate (with respect of the solute). Experiments are described in which bulk solutions typical of atmospheric aerosols (nitric acid, sulfuric acid, and hydrates; ammonium sulfate; ammonium bisulfate; sodium chloride) are supercooled and/or supersaturated and nucleated to initiate crystal growth. Supersaturation of 300 percent is readily attainable, with linear growth of crystals increasing roughly as (supercooling/supersaturation) sup 2. The implication of the experiments is that the situation of metastability in polar stratosphere clouds is very likely, with nucleation only occuring under a high degree of supercooling or supersaturation. Author

**N91-32534*#** Wyoming Univ., Laramie. Dept. of Physics and Astronomy.
**MEASUREMENTS IN POLAR STRATOSPHERIC CLOUDS OVER ANTARCTICA IN SEPTEMBER 1989 Abstract Only c46**
Terry Deshler *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 48 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

The results of six balloon flights at McMurdo Station, Antarctica, under varying temperature conditions, are used in a study of polar stratospheric clouds during Sept. 1989. A particle counter, with size resolution in the 0.5 micron radius region, indicates that cloud size distributions are always bimodal. Mode radii ranging from 0.05 to 0.10 microns were observed for the small particle mode, representing the sulfate layer or condensational growth enhancements of it. The data are not inconsistent with the expected increase in size with decreasing temperature of the small particle mode in the sulfate layer owing to deliquescence although this phenomenon is often masked by nitric acid trihydrate (NAT) condensation when temperatures are sufficiently low. Mode radii generally ranged from 1.5 to 3.5 micron for the large particle mode at concentrations 3 to 4 orders of magnitude lower than the small particle mode. The large particle mode, which normally comprises most of the mass, is presumably caused by NAT condensation on larger particles of the sulfate layer and indicates HNO3 mixing ratios of 1 to 5 ppbv for most of the cloud layers observed, suggesting substantial denitrification. On several occasions, distributions were observed with mode radii as high as 7 microns, and correspondingly large inferred mass, indicating water ice clouds in the 12 to 15 km region. On other occasions, absence of such clouds at very low temperatures indicated water vapor mixing ratios of less than 3 ppmv suggesting dehydration. Generally, the inferred HNO3 mixing ratios were higher in the lower stratosphere, suggesting redistribution through particle sedimentation. Author

**N91-32535*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**VALIDATION OF LIDAR AND SATELLITE REMOTE SENSING Abstract Only c46**
M. P. McCormick *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 49 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

Validation of observations is an important part of any remote sensing program. With respect to aerosols this is exceedingly difficult because each technique typically measures a different aerosol parameter. Correlative sensors, therefore, must be capable of measuring the same parameter over the same size range or include enough measurements to properly characterize the aerosol, possibly with the assistance of models. In any correlative measurement program, simultaneity in space and time is required. This can be less restrictive during periods of atmospheric stability. The discussion is presented which is focused on the validation programs developed for NASA's Stratospheric Aerosol Measurement (SAM II), and the Stratospheric Aerosol and Gas Experiments I and II (SAGE I and II). To date these were limited to the stratosphere. Since satellite sensors are capable of providing near-global and long-term observations, periodic correlative observations over various global locations and seasons are required for assuring that data quality is unchanged, or for understanding any changes observed. Author

**N91-32536*#** Fraunhofer-Inst. fuer Atmosphaerische Umweltforschung, Garmisch-Partenkirchen (Germany, F.R.).
**LIDAR MEASUREMENTS AT GARMISCH, CONVERSION MODEL, AND MIDLATITUDE AEROSOL EFFECTS Abstract Only c46**
Horst Jaeger *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 50 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

Lidar backscatter soundings of stratospheric aerosol layer were routinely made at the IFU, Garmisch-Partenkirchen. After 1979 significant perturbations of the stratosphere were observed after volcano eruptions from 1980 to 1985. A volcanically quiescent period followed until the eruption at the end of 1989. Determinations of particle extinction, mass and surface area of the stratospheric particulate load are important in climatic considerations and heterogeneous chemistry effects. Balloon-borne particle counter

measurements are used to derive height and time resolved conversion factors to convert lidar backscatter data to extinction, mass and surface area values. This is done by combining particle size distributions with Mie backscatter and extinction functions. These conversion factors are applicable to midlatitude lidar observations and were used to convert ruby lidar measurement at the IFU. Author

**N91-32537*#** Consiglio Nazionale delle Ricerche, Florence (Italy). Ist. di Ricerca sulle Onde Elettromagnetiche.

**POLAR STRATOSPHERIC CLOUD MEASUREMENTS BY MEANS OF DEPOLARIZATION LIDAR IN THE ANTARCTIC Abstract Only** **c46**

L. Stefanutti *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 51-53 (For primary document see N91-32528 24-43)

Avail: NTIS HC/MF A05 CSCL 04A

POLE (Polar Ozone Lidar Experiment) is a cooperative project between the French and Italian services. It was started with the implementation of a first depolarization backscattering lidar for measurements both of background stratospheric aerosols and Polar Stratospheric Clouds (PSCs). A complex Ozone lidar was also installed which will replace the backscattering system and extend its measurements to tropospheric and stratospheric Ozone and to stratospheric and mesospheric temperatures. This new system allows also the measurement of the backscattered and depolarized signal produced by PSCs and background aerosols. The depolarization technique seemed to be quite efficient in the detection of different types of PSCs. Author

**N91-32538*#** Universite des Sciences et Techniques de Lille (France). Lab. d'Optique Atmospherique.

**AEROSOL SENSING FROM BALLOONS USING PHOTOPOLARIMETRY Abstract Only** **c46**

R. Santer, B. S. Diallo, and M. Herman *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 56 (For primary document see N91-32528 24-43)

Avail: NTIS HC/MF A05 CSCL 04A

A photopolarimeter designed to measure the radiance and the polarization ratio at lambda equals 0.85 microns and lambda equals 1.65 microns is set up on a gondola of a stratospheric balloon. By rotating the gondola, measurements of the diffuse solar light are obtained for a wide range of the scattering angles. An inversion scheme, based on the assumption of a log-normal size distribution, provides the relevant size parameters, the refractive index, and the slant optical thicknesses of the aerosols. Since 1983, this experiment was launched twice a year from Aire Sur Adour (S-E of France). The post-El Chichon atmospheric stratospheric aerosol proved to be quite stable in size and nature (hydratid sulfuric acid), but the abundance decreased by a factor of 10 between 1983 and 1987. The experiment was also launched to observe the stratosphere during the Arctic winter. Two flights, on January 28, 1988 and January 18, 1990, corresponded to an unperturbed atmosphere. But during a third flight, on April, 2, 1990, the temperatures were low enough for PCS formulations. A multilayer situation was observed with the standard H2SOH aerosols below 20 km; a dense layer was observed, peaked at around 23 km, with scattering coefficients about 50 times layer than in background conditions; and an upper layer was observed, rather sharp (approximately equal to 1 km), with micron sized particles. Author

**N91-32539*#** Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.

**THE EFFECTS OF SULFATE AND SOOT IN SMOKE ON ATMOSPHERIC EXTINCTION Abstract Only** **c46**

Weihan Su *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 57 (For primary document see N91-32528 24-43)

Avail: NTIS HC/MF A05 CSCL 04A

There was a big forest fire in Northeastern China in May, 1987. An apparently new aerosol layer was detected at the base of the stratosphere. The fire burned from about 6 to 28 May 1987 and produced extensive clouds of smoke that were tracked for thousands of kilometers using NOAA weather satellite imagery. It was found that during and just after this fire, the concentration of particles in the upper tropopause and lower stratosphere above the Pacific Ocean and North America increased as much as 10 times normal concentrations. The increase of the atmospheric extinction coefficient was contributed mostly by sulfates and soot resulting from biomass burning and coal combustion. It was shown that their contributions can reach 80 to 90 percent of the whole extinction coefficient. The forest fire can inject smoke high into the atmosphere, resulting in an increase in atmospheric extinction that might lead to a climate perturbation. Author

**N91-32540*#** Academia Sinica, Hefei (China). Inst. of Optics and Fine Mechanics.

**A LIDAR EQUIPPED WITH PHOTON COUNTER FOR MEASURING STRATOSPHERIC AEROSOLS Abstract Only** **c46**

Jun Zhou and Huanling Hu *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 59 (For primary document see N91-32528 24-43)

Avail: NTIS HC/MF A05 CSCL 04A

A large lidar system was developed at the Anhui Institute of Optics and Fine Mechanics. It is composed of a high power frequency doubled Nd:YAG laser (120 mJ at 532 nm, 1 mrad), a 651 mm diameter receiving telescope, and a 64 channel photon counter. The lidar observations are controlled by an IBM PC/AT computer. One of the projects is to use the lidar system to make regular observations of stratospheric aerosols. Profiles of scattering ratio have been obtained since November 1989. Meanwhile, an Xe-Cl laser (308 nm wavelength) was assembled to allow the lidar to make measurements of vertical ozone distributions. Author

**N91-32541*#** Kernforschungszentrum G.m.b.H., Karlsruhe (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik.

**IN SITU MEASUREMENTS OF LIGHT EXTINCTION OF STRATOSPHERIC AEROSOLS Abstract Only** **c46**

Gunthard Metzig *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 59 (For primary document see N91-32528 24-43)

Avail: NTIS HC/MF A05 CSCL 04A

The extinction coefficient of ambient aerosol particles was measured using a multiple transverse cell (White Cell) with an effective path length of 100 m. Measurements were performed at seven fixed wavelengths in the visible region using a white light source and an interference filter set with 2 nm bandwidth and center wavelengths of 405.5, 450, 500, 550, 600, 650, and 692.5 nm. The total air flow in the system was 16.7 1/min; the volume of the chamber is close to 10 liters. It takes about one minute to fill the chamber with particles homogeneously, but it needs up to five minutes to get the chamber particle-free. Before measuring the aerosol, the transmission of the particle-free air is determined; then the aerosol passes through the chamber for a period of ten minutes; after this the transmission of particle-free ambient air is measured again for eight minutes. All times are subject to change. At present the measurements are done with a frequency of 1 Hz, but an increase of up to 30 Hz is possible. The lower detection limit of the used White Cell is 3.4 by 10(exp -06) per m. This is sufficient for measuring the extinction coefficient during most tropospheric and some stratospheric conditions. It will be necessary to increase the sensitivity by a factor of ten when measurements under the clearest stratospheric conditions take place. Author

**N91-32542#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Fernerkundungsanwendungen.
**AUTOMATIC LAND-USE CLASSIFICATION USING LANDSAT-5 THEMATIC MAPPER DATA IN A REGION OF THE ITZEHOER GEEST. AN ATTEMPT TO IMPROVE MAPPING BY COMBINATION WITH PANCHROMATIC SPOT DATA Thesis - Trier Univ.**
Willibald Croi Oct. 1990 124 p In GERMAN; ENGLISH summary Original contains color illustrations
(DLR-FB-90-47; ISSN-0939-2963; ETN-91-90035) Avail: NTIS HC/MF A06; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 49.50 DM

The land use of a region in the Itzehoer Geest is recorded by maximum likelihood classification of LANDSAT 5 TM (Thematic Mapper) data of July 7, 1987. A panchromatic SPOT scene of the same region is adjusted to the LANDSAT 5 TM data using reference points. Both data sets were combined by digital image processing techniques. The new image has an artificially increased geometric solution. To improve mapping, edge information from the panchromatic SPOT scene is integrated into the result of the maximum likelihood classification. ESA

**N91-32543#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Fernerkundungsanwendungen.
**PARAMETRIC RECTIFICATION OF THEMATIC MAPPER RAW DATA Thesis - Technische Univ.**
Hardy Ehrhardt Oct. 1990 105 p In GERMAN; ENGLISH summary Original contains color illustrations
(DLR-FB-90-55; ISSN-0939-2963; ETN-91-90036) Avail: NTIS HC/MF A06; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 43 DM

The application of LANDSAT Thematic Mapper (TM) image data can be optimized using precise preprocessing techniques for TM data. The geometric correction algorithm used in commercial operational geocoding systems still has defects, reducing the image accuracy. A new model for geometric corrections is introduced. Supplementary data containing information about scan mirror motion, attitude and ephemeris data is used as well as information extracted from the image data themselves. This is done by a correlation analysis between adjacent image lines. This new model is applied to the LANDSAT TM scene 193-26 of April 29, 1987. The quality of this new model is verified using independent control points. ESA

**N91-32544#** Lawrence Livermore National Lab., CA.
**AN ANALOG RETINA MODEL FOR DETECTING MOVING OBJECTS AGAINST A MOVING BACKGROUND**
R. M. Searfus, F. H. Eeckman, M. E. Colvin, and T. S. Axelrod Mar. 1991 7 p Presented at the SPIE International Symposium on Optical Engineering and Photonics in Aerospace Sensing, Orlando, FL, 1-5 Apr. 1991
(Contract W-7405-eng-48)
(DE91-017428; UCRL-JC-106792; CONF-910450-15) Avail: NTIS HC/MF A02

Many applications require the ability to detect and track moving objects against moving backgrounds. If an object's signal is less than or comparable to the variations in the background, sophisticated techniques must be employed to detect the object. We present an analog retina model that adapts to the motion of the background in order to enhance objects moving with a velocity different than the background velocity. A computer simulation that preserves the analog nature of this model and its application to real and simulated data are described. Our preliminary concept of an analog Z focal plane implementation is also presented. DOE

**N91-32545*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**CONTOUR-MAP ENCODING OF SHAPE FOR EARLY VISION**
Pentti Kanerva Feb. 1990 10 p
(Contract NCC2-387)
(NASA-CR-188937; NAS 1.26:188937; RIACS-TR-90-5) Avail: NTIS HC/MF A02 CSCL 08B

Contour maps provide a general method for recognizing 2-D shapes. All but blank images give rise to such maps, and people are good at recognizing objects and shapes from them. The maps are encoded easily in long feature vectors that are suitable for recognition by an associative memory. These properties of contour maps suggest a role for them in early visual perception. The prevalence of direction sensitive neurons in the visual cortex of mammals supports this view. Author

**N91-32546*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**GENERATION OF TOPOGRAPHIC TERRAIN MODELS UTILIZING SYNTHETIC APERTURE RADAR AND SURFACE LEVEL DATA Patent**
Marc L. Imhoff, inventor (to NASA) 1 Oct. 1991 14 p Filed 10 Aug. 1989
(NASA-Case-GSC-13212-1; US-Patent-5,053,778; US-Patent-Appl-SN-391896; US-Patent-Class-342-191; US-Patent-Class-342-25; US-Patent-Class-342-26; Int-Patent-Class-G01S-13/89) Avail: US Patent and Trademark Office CSCL 08B

Topographical terrain models are generated by digitally delineating the boundary of the region under investigation from the data obtained from an airborne synthetic aperture radar image and surface elevation data concurrently acquired either from an airborne instrument or at ground level. A set of coregistered boundary maps thus generated are then digitally combined in three dimensional space with the acquired surface elevation data by means of image processing software stored in a digital computer. The method is particularly applicable for generating terrain models of flooded regions covered entirely or in part by foliage.
Official Gazette of the U.S. Patent and Trademark Office

**N91-32547** Deutsche Geodaetische Kommission, Munich (Germany, F.R.).
**INTEGRATED COMPENSATION OF GEODETIC NETS IN POINT MASSES MODEL Ph.D. Thesis - Karlsruhe Univ. [INTEGRIERTE AUSGLEICHUNG GEODAETISCHER NETZE IM MASSENPUNKTMODELL]**
Tilman Mueller 1990 100 p In GERMAN
(Ser-C-362; ISBN-3-7696-9410-4; ISSN-0065-5325; ETN-91-90014) Copyright Avail: Deutsche Geodaetische Kommission, Bayerischen Akademie der Wissenschaften, Marstallplatz 8, D-8000 Munich 22, Fed. Republic of Germany

Compensation models of three dimensional geodesy and integrated net compensation are presented. A functional and statistical description of the gravitational field by spherical function, development and point masses is given. The integrated net compensation with point masses is examined. Technical computations are considered with regard to a point masses model. It is shown that a great number of various covariance functions of the noise potential can be represented in a point masses model. ESA

**N91-32548** Deutsche Geodaetische Kommission, Munich (Germany, F.R.).
**THE 1980 EQUALIZATION DIAGNOSIS OF THE GERMAN MAIN TRIANGULATION NETWORK. 5: NEIGHBORHOOD, CONCLUSIONS [DIE DIAGNOSEAUSGLEICHUNG 1980 DES DEUTSCHEN HAUPDREIECKNETZES. 5: NACHBARSCHAFT, SCHLUSSFOLGERUNGEN]**
Dieter Ehlert and Robert Strauss 1990 148 p In GERMAN Original contains color illustrations
(Ser-B-272-Pt-2; ISSN-0071-9196; ETN-91-90057) Copyright Avail: Deutsche Geodaetische Kommission, Bayerischen Akademie der Wissenschaften, Marstallplatz 8, D-8000 Munich 22, Fed. Republic of Germany

How to obtain neighborhood accuracy is shown. The coordinates of the German main triangulation net, and the coordinates of the combined equalized diagnosis net are presented.

The origins of the divergences are given. Stochastic and functional models are presented. Transformation formulas are given. The results of the field copies of the central system are tabulated and evaluated. The possibilities of eliminating the defects of the German main triangulation net are discussed. It is shown that it needs higher scientific accuracy. ESA

# 44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

**N91-32549*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**SPACE ELECTROCHEMICAL RESEARCH AND TECHNOLOGY**
Sep. 1991 244 p Third Conference held in Cleveland, OH, 9-10 Apr. 1991
(NASA-CP-3125; E-6089; NAS 1.55:3125) Avail: NTIS HC/MF A11 CSCL 10A

The proceedings of NASA's third Space Electrochemical Research and Technology (SERT) conference are presented. The objective of the conference was to assess the present status and general thrust of research and development in those areas of electrochemical technology required to enable NASA missions in the next century. The conference provided a forum for the exchange of ideas and opinions of those actively involved in the field, in order to define new opportunities for the application of electrochemical processes in future NASA missions. Papers were presented in three technical areas: the electrochemical interface, the next generation in aerospace batteries and fuel cells, and electrochemistry for nonenergy storage applications. For individual titles, see N91-32550 through N91-32567.

**N91-32550*#** EMEC Consultants, Export, PA.
**ELECTROLYTIC PRODUCTION OF OXYGEN FROM LUNAR RESOURCES** **c25**
Rudolf Keller *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 1-6 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 07D

Some of the most promising approaches to extract oxygen from lunar resources involve electrochemical oxygen generation. In a concept called magma electrolysis, suitable oxides (silicates) which are molten at 1300 to 1500 C are then electrolyzed. Residual melt can be discarded after partial electrolysis. Alternatively, lunar soil may be dissolved in a molten salt and electrolyzed. In this approach, temperatures are lower and melt conductances higher, but electrolyte constituents need to be preserved. In a different approach ilmenite is reduced by hydrogen and the resulting water is electrolyzed. Author

**N91-32551*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**THE Au CATHODE IN THE SYSTEM Li2CO3-CO2-CO AT 800 TO 900 C**
Norman H. Hagedorn *In its* Space Electrochemical Research and Technology Sep. 1991 p 7-22 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10C

Current results of experimental work to evaluate gold as a possible catalyst for the cathodic reduction of carbon dioxide in molten lithium carbonate are presented. An attempt is then made to rationalize the experimental results by proposing a phenomen logical model for the sequence of reactions at and around the electrode. Finally, inferences are made as to the viability of gold as a cathode catalyst for the proposed battery. Author

**N91-32552*#** Hamilton Standard, Windsor Locks, CT.
**SPE (TM) WATER ELECTROLYZERS IN SUPPORT OF MISSION FROM PLANET EARTH**
J. F. McElroy *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 23-35 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

During the 1970's, the Solid Polymer Electrolyte (SPE) water electrolyzer, which uses ion exchange membranes as its sole electrolyte, was developed for nuclear submarine metabolic oxygen production. SPE water electrolyzer developments included operation at up to 3,000 psia and at current densities in excess of 1,000 amps per square foot. The SPE water electrolyzer system has accumulated tens of thousands of system hours with the Navies of both the United States and the United Kingdom. During the 1980's, the basic SPE water electrolyzer cell structure developed for the Navies was incorporated into several demonstrators for NASA's Space Station Program. Among these were: (1) the SPE regenerative fuel cell for electrical energy storage; (2) the SPE water electrolyzer for metabolic oxygen production; and (3) the high pressure SPE water electrolyzer for reboost propellant production. In the 1990's, emphasis will be the development of SPE water electrolyzers for Mission from Planet Earth. Currently defined potential applications for the SPE water electrolyzer include: (1) SPE water electrolyzers operating at high pressure as part of a regenerative fuel cell extraterrestrial surface energy storage system; (2) SPE water electrolyzers for propellant production from extraterrestrial indigenous materials; and (3) SPE water electrolyzers for metabolic oxygen and potable water production from reclaimed water. Author

**N91-32553*#** Life Systems, Inc., Cleveland, OH.
**SPACE WATER ELECTROLYSIS: SPACE STATION THROUGH ADVANCE MISSIONS**
Ronald J. Davenport, Franz H. Schubert, and David J. Grigger *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 37-56 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

Static Feed Electrolyzer (SFE) technology can satisfy the need for oxygen (O2) and Hydrogen (H2) in the Space Station Freedom and future advanced missions. The efficiency with which the SFE technology can be used to generate O2 and H2 is one of its major advantages. In fact, the SFE is baselined for the Oxygen Generation Assembly within the Space Station Freedom's Environmental Control and Life Support System (ECLSS). In the conventional SFE process an alkaline electrolyte is contained within the matrix and is sandwiched between two porous electrodes. The electrodes and matrix make up a unitized cell core. The electrolyte provides the necessary path for the transport of water and ions between the electrodes, and forms a barrier to the diffusion of O2 and H2. A hydrophobic, microporous membrane permits water vapor to diffuse from the feed water to the cell core. This membrane separates the liquid feed water from the product H2, and, therefore, avoids direct contact of the electrodes by the feed water. The feed water is also circulated through an external heat exchanger to control the temperature of the cell. Author

**N91-32554*#** Aerospace Corp., El Segundo, CA.
**THE EFFECTS OF PLATINUM ON NICKEL ELECTRODES IN THE NICKEL HYDROGEN CELL**
Albert H. Zimmerman *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 57-71 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

Interactions of platinum and platinum compounds with the nickel electrode that are possible in the nickel hydrogen cell, where both the nickel electrode and a platinum catalyst hydrogen electrode are in intimate contact with the alkaline electrolyte, are examined. Additionally, a mechanism of nickel cobalt oxyhydroxide formation in NiH2 cells is presented. Author

**N91-32555*#** Communications Satellite Corp., Clarksburg, MD.
**PHYSICAL AND CHEMICAL ANALYSIS OF A Ni/H2 CELL**
H. Vaidyanathan, M. W. Earl, and T. D. Kirkendall *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 73-80 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

A cycled aerospace nickel hydrogen (Ni/H2) cell was subjected to destructive physical analysis to determine the reason for a capacity loss after 5,967 cycles at 60 percent depth of discharge. The positive plates in the cell were analyzed in terms of chemical composition, active material utilization, charge efficiency, and thickness increase. The microstructure of a cross section of the positive plate was determined by backscattered electron image analysis. The results suggest that the capacity loss in the cell is caused by low charge acceptance and low active material utilization at the positive plate. The oxidized nickel species content of the positive plate increased due to corrosion of the nickel sintered skeleton. This appears to circumvent the orderly reaction of the active material. Microstructural analysis has indicated that a new phase of active material is formed with cycling. Author

**N91-32556*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**RAMAN SPECTRAL OBSERVATION OF A NEW PHASE OBSERVED IN NICKEL ELECTRODES CYCLED TO FAILURE**
Patricia L. Loyselle, X. Shan, B. C. Cornilsen (Michigan Technological Univ., Houghton.), and Margaret A. Reid *In its* Space Electrochemical Research and Technology Sep. 1991 p 81-87 (For primary document see N91-32549 24-44)
(Grant NAG3-519)
Avail: NTIS HC/MF A11 CSCL 10B

A new phase is reported in nickel electrodes from Ni/H2 boilerplate cells which were cycled to failure in electrolyte of variable KOH concentration (21 to 36 percent). Raman spectra clearly show the presence of this phase, and these spectra have been used to estimate the amounts present on these electrodes. Ten of 12 electrodes examined contain this new phase. The cycle life at higher KOH concentrations (31 and 36 percent) was greatly reduced, and nickel electrodes from these cells exhibited extensive amounts of this new phase. The presence of this new phase correlates with cell failure defined by low end of discharge voltages. It is proposed that the lowered capacity and failure of these electrodes was caused by loss of active mass and formation of a phase with reduced electrochemical activity. These results indicate that formation of the new phase is accelerated at higher KOH concentrations. Author

**N91-32557*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**IMPEDANCES OF NICKEL ELECTRODES CYCLED IN VARIOUS KOH CONCENTRATIONS**
Margaret A. Reid and Patricia L. Loyselle *In its* Space Electrochemical Research and Technology Sep. 1991 p 89-100 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

Recent tests at Hughes have shown that Ni/H2 cells cycled in 26 percent KOH have much longer lives than those cycled in other concentrations. As part of an ongoing program to try to correlate the impedances of nickel electrodes with their life and performance, impedances were measured of a number of electrodes from these tests that had been cycled in concentrations from 21 to 36 percent KOH. These had ranged from about 1000 to 40,000 cycles. After cycling ten times to reduce possible changes due to storage, impedances were measured at five voltages corresponding to low states of charge. The results were analyzed using a standard circuit model including Warburg impedance term. Lower kinetic resistances and Warburg slopes were found for several electrodes which had been cycled in 26 percent KOH even though they had been cycled for a much longer time than the others. Interpretation of the data is complicated by the fact that the cycle lives, storage times, and failure mechanisms varied. Several other circuit models have also been examined, but the best correlations with life were found with parameters obtained from the simple model. Author

**N91-32558*#** Texas A&M Univ., College Station. Center for Electrochemical Systems and Hydrogen Research.
**HIGH ENERGY EFFICIENCY AND HIGH POWER DENSITY PROTON EXCHANGE MEMBRANE FUEL CELLS: ELECTRODE KINETICS AND MASS TRANSPORT**
Supramaniam Srinivasan, Omourtag A. Velev, Arvind Parthasathy, David J. Manko, and A. John Appleby *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 101-122 Sponsored by NASA. Johnson Space Center; DOE; and DARPA (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

The development of proton exchange membrane (PEM) fuel cell power plants with high energy efficiencies and high power densities is gaining momentum because of the vital need of such high levels of performance for extraterrestrial (space, underwater) and terrestrial (power source for electric vehicles) applications. Since 1987, considerable progress has been made in achieving energy efficiencies of about 60 percent at a current density of 200 mA/sq cm and high power densities (greater than 1 W/sq cm) in PEM fuel cells with high (4 mg/sq cm) or low (0.4 mg/sq cm) platinum loadings in electrodes. The following areas are discussed: (1) methods to obtain these high levels of performance with low Pt loading electrodes - by proton conductor impregnation into electrodes, localization of Pt near front surface; (2) a novel microelectrode technique which yields electrode kinetic parameters for oxygen reduction and mass transport parameters; (3) demonstration of lack of water transport from anode to cathode; (4) modeling analysis of PEM fuel cell for comparison with experimental results and predicting further improvements in performance; and (5) recommendations of needed research and development for achieving the above goals. Author

**N91-32559*#** Case Western Reserve Univ., Cleveland, OH. Center for Electrochemical Sciences.
**I-BIEM CALCULATIONS OF THE FREQUENCY DISPERSION AND AC CURRENT DISTRIBUTION AT DISK AND RING-DISK ELECTRODES**
Boris D. Cahan *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 123-146 Sponsored in part by Ohio Aerospace Inst. (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

The Iterative Boundary Integral Equation Method (I-BIEM) has been applied to the problem of frequency dispersion at a disk electrode in a finite geometry. The I-BIEM permits the direct evaluation of the AC potential (a complex variable) using complex boundary conditions. The point spacing was made highly nonuniform, to give extremely high resolution in those regions where the variables change most rapidly, i.e., in the vicinity of the edge of the disk. Results are analyzed with respect to IR correction, equipotential surfaces, and reference electrode placement. The current distribution is also examined for a ring-disk configuration, with the ring and the disk at the same AC potential. It is shown that the apparent impedance of the disk is inductive at higher frequencies. The results are compared to analytic calculations from the literature, and usually agree to better than 0.001 percent. Author

**N91-32560*#** Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
**REGENERATIVE FUEL CELL ARCHITECTURES FOR LUNAR SURFACE POWER**
D. W. Harris, S. P. Gill, T. M. Nguyen, and J. J. Vrolyk *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 147-154 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

Various Regenerative Fuel Cell (RFC) configurations for the

stationary lunar missions were examined using a RFC computer model. For the stationary applications, a GaAs/Ge photovoltaic (PV) array with a 3000 psi gas storage proton exchange membrane (PEM) RFC providing 25 kWe during the day and 12.5 kWe at night was designed. PV/RFC systems utilizing supercritical H2/O2 storage and cryogenic H2/O2 storage for the RFCs were then compared with the baseline high pressure gas storage RFC system. Preliminary results indicate that for long duration nighttime operation missions, the supercritical H2/O2 storage RFC systems offer over 20 percent mass advantage over the high pressure gas storage while the mass savings for the cryogenic H2/O2 storage RFC systems can be as high as 30 percent. Author

**N91-32561*#** Giner, Inc., Waltham, MA.
**OXYGEN ELECTRODES FOR RECHARGEABLE ALKALINE FUEL CELLS, 3**
L. Swette, N. Kackley, and S. A. McCatty *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 155-173 (For primary document see N91-32549 24-44)
(Contract NAS3-24635)
Avail: NTIS HC/MF A11 CSCL 10B

The investigation and development of electrocatalysts and supports for the positive electrode of moderate temperature single unit rechargeable alkaline fuel cells is described. Focus is on chemical and electrochemical stability and O2 reduction/evolution activity of the electrode in question. Author

**N91-32562*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**SOME RECENT STUDIES WITH THE SOLID-IONOMER ELECTROCHEMICAL CAPACITOR**
S. Sarangapani, J. Forchione, A. Griffith, A. B. LaConti (Giner, Inc., Waltham, MA.), and R. Baldwin *In its* Space Electrochemical Research and Technology Sep. 1991 p 175-193 (For primary document see N91-32549 24-44)
(Contract N00014-88-C-0391; NSF ISI-90-60142)
Avail: NTIS HC/MF A11 CSCL 10B

A high energy density, all solid ionomer electrochemical capacitor was developed, which is completely free of liquid electrolyte. The novel features of this device include a three dimensional metal oxide particulate ionomer composite electrode structure, and a unitized repeating cell element. The composite electrode structures are bonded to opposite sides of a thin sheet of a solid proton conducting ionomer membrane and form an integrally bonded membrane and electrode assembly (MEA). Individual MEAs can be stacked in series as bipolar elements to form a multiple cell device. The discharge characteristics and energy storage properties of these devices are described. Typical capacitance measured for a unit cell is 1 F/sq cm. Life testing of a multicell capacitor on an intermittent basis has shown, that over a 10,000 hour period, the capacitance and resistance of the cell has remained invariant. There has been no maintenance required on the device since it was fabricated. Other multicell units of shorter life duration have exhibited similar reliable performance characteristics. Author

**N91-32563*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**PERFORMANCE OF A DUAL ANODE NICKEL-HYDROGEN CELL**
Randall F. Gahn *In its* Space Electrochemical Research and Technology Sep. 1991 p 195-207 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

An experimental study was conducted to characterize the voltage performance of a nickel hydrogen cell containing a hydrogen electrode on both sides of the nickel electrode. The dual anode cell was compared with a convenient single anode cell using the same nickel electrode. Higher discharge voltages and lower charge voltages were obtained with the dual anode cell during constant current discharges to 10C, pulse discharges to 8C, and polarization measurements at 50 percent of charge. Author

**N91-32564*#** Johnson Controls, Inc., Milwaukee, WI. Nickel Hydrogen Battery Div.
**MULTIPLE CELL COMMON PRESSURE VESSEL NICKEL HYDROGEN BATTERY**
Jeffrey P. Zagrodnik and Kenneth R. Jones *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 209-220 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

A multiple cell common pressure vessel (CPV) nickel hydrogen battery was developed that offers significant weight, volume, cost, and interfacing advantages over the conventional individual pressure vessel (IPV) nickel hydrogen configuration that is currently used for aerospace applications. The baseline CPV design was successfully demonstrated though the testing of a 26 cell prototype, which completed over 7,000 44 percent depth of discharge LEO cycles. Two-cell boilerplate batteries have now exceeded 12,500 LEO cycles in ongoing laboratory tests. CPV batteries using both nominal 5 and 10 inch diameter vessels are currently available. The flexibility of the design allows these diameters to provide a broad capability for a variety of space applications. Author

**N91-32565*#** Eagle-Picher Industries, Inc., Joplin, MO.
**SMALL CAPACITY, LOW COST (Ni-H2) DESIGN CONCEPT FOR COMMERCIAL, MILITARY, AND HIGHER-VOLUME AEROSPACE APPLICATIONS**
James R. Wheeler, William D. Cook, and Ron Smith *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 221-226 Previously announced in IAA as A91-27488 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

Nickel Hydrogen (Ni/H2) batteries have become the technology of choice for both commercial and defense related satellites in geosynchronous orbits. Their use for low earth orbit (LEO) applications is not as advanced, but seems just as inevitable because of their inherent advantages over nickel cadmium batteries. These include superior energy density, longer cycle life, and better tolerance to over-charge and reversal. Ni/H2 cells have the added advantage in both construction and operation of not presenting the environmental possibility of cadmium pollution. Unfortunately, but necessarily, the design of these cells has been driven to high cost by the sophistication of the satellites and their uses. Now, using most of the same concepts but less costly materials and techniques, a low cost, small cell design was developed. Combined with the concept of the common pressure vessel, this new design promises to be ideal for the small-sat and commercial markets which, increasingly, are calling for large numbers of less expensive satellites. Author

**N91-32566*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SODIUM-METAL CHLORIDE BATTERY RESEARCH AT JPL**
B. V. Ratnakumar, A. I. Attia, and G. Halpert *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 227-234 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

Sodium metal chloride batteries have certain distinct advantages over sodium sulfur batteries such as increased safety, inherent overcharge capability and lower operation temperatures. Two systems, i.e., Na/FeCl2 and Na/NiCl2 were developed extensively elsewhere and evaluated for various applications including electric vehicles and space. Their performance has been very encouraging and prompted a detailed fundamental study of these cathodes here at the Jet Propulsion Laboratory. A brief review of our studies on these new cathode materials is presented here. The initial efforts focussed on the methods of fabrication of the electrodes and their electrochemical characterization. Subsequent studies were aimed at establishing the reaction

mechanism, determining the kinetics and identifying the rate limiting processes in the reduction of metal chloride cathodes. Nickel chloride emerged from these studies as the most promising candidate material and was taken up for further detailed study on its passivation - a rate limiting process - under different experimental conditions. Also, the feasibility of using copper chloride, which is expected to have higher energy density, has been assessed. Based on the criteria established from the voltammetric response of FeCl2, NiCl2, and CuCl2, several other transition metal chlorides were screened. Of these, molybdenum and cobalt chlorides appear promising. Author

**N91-32567*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**ADVANCES IN Li-TiS2 CELL TECHNOLOGY**
S. Surampudi, D. H. Shen, C.-K. Huang, F. Deligiannis, A. I. Attia, and G. Halpert *In* NASA. Lewis Research Center, Space Electrochemical Research and Technology Sep. 1991 p 235-244 (For primary document see N91-32549 24-44)
Avail: NTIS HC/MF A11 CSCL 10B

Jet Propulsion Laboratories (JPL) is involved in a NASA sponsored program to develop ambient temperature secondary cells for future space missions. After several years of research on various cathode materials, titanium disulfide (TiS2) was selected in view of its intrinsic reversibility and high faradaic utilization. In the last two years, the efforts were focussed on improving the cycle life of the system and developing 1 Ah cells. Several approaches including the use of mixed solvent electrolytes, the operation of cells at low temperature, and the cycling of cells under different voltage limits, were initially examined to improve the cycle life performance of the Li/TiS2 system. Spiral wound 1 Ah cells fabricated incorporating the improvements from the above studies have delivered more than 600 cycles at 50 percent depth of discharge (DOD). Work is in progress to identify alternate anode materials that can improve the cycle life of the cells to 1000 cycles at 50 percent DOD. The advances made in the Li/TiS2 technology at JPL since 1989 are summarized. Author

**N91-32568#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany, F.R.). Energetics Research Div.
**TO WHAT EXTENT CAN RENEWABLE ENERGY (RE) SYSTEMS REPLACE CARBON-BASED FUELS IN THE NEXT 15, 50, AND 100 YEARS? EIGHT ANSWERS**
Carl-Jochen Winter Feb. 1991 51 p Presented at the Dahlem Workshop on Limiting the Greenhouse Effect: Options for Controlling Atmospheric CO2 Accumulation, Berlin, Fed. Republic of Germany, 9-14 Dec. 1990 Original contains color illustrations
(DLR-Mitt-91-04; ISSN-0939-298X; ETN-91-90032) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 14.50 DM

The attractiveness of renewable energies as a replacement for the fossil energies is discussed. Encouragement for their use is given on the basis that they do not require primary energy raw materials and cannot give rise to any of the pollutants which have their source in these materials. The solution of technical problems will not be in the forefront for the foreseeable future. In much more urgent need of adaptation to the special character of renewable energies are energy legislation, energy regulations, the complete internalization of external costs, replacing the now dominant primary energy economy with an energy services economy, and people's energy related attitudes and behavior.
ESA

**N91-32569*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**STATUS OF NASA'S STIRLING SPACE POWER CONVERTER PROGRAM**
James E. Dudenhoefer and Jerry M. Winter 1991 8 p Presented at the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, 4-9 Aug. 1991; sponsored by ANS, SAE, ACS, AIAA, ASME, IEEE, and AIChE
(NASA-TM-104512; E-6381; NAS 1.15:104512) Avail: NTIS HC/MF A02 CSCL 10B

An overview is presented of the NASA-Lewis Free-Piston Stirling Space Power Convertor Technology Program. The goal is to develop the technology base needed to meet the long duration, high capacity power requirements for future NASA space initiatives. Efforts are focused upon increasing system power output and system thermal and electric energy conversion efficiency at least fivefold over current SP-100 technology, and on achieving systems that are compatible with space nuclear reactors. Stirling experience in space and progress toward 1050 and 1300 K Stirling Space Power Converters is discussed. Fabrication is nearly completed for the 1050 K Component Test Power Converters (CTPC); results of motoring tests of cold end (525 K), are presented. The success of these and future designs is dependent upon supporting research and technology efforts including heat pipes, bearings, superalloy joining technologies, high efficiency alternators, life and reliability testing and predictive methodologies. An update is provided of progress in some of these technologies leading off with a discussion of free-piston Stirling experience in space. Author

**N91-32570#** International Fuel Cells Corp., South Windsor, CT.
**IMPACT OF FUNDAMENTAL TECHNICAL IMPROVEMENTS TO NATURAL GAS FUEL CELLS Final Report**
D. L. Maricle May 1991 30 p
(Contract GRI-5086-260-1398)
(PB91-206615; FCR-11645A; GRI-91/0139) Avail: NTIS HC/MF A03 CSCL 10B

Subscale cell test results with both bis-phosphonic and sulfonyl carbon electrolytes indicate that oxygen reduction activity was enhanced above that of phosphoric acid. The activity measured with the novel acids vs. control cells was larger for the novel acids and it was also larger than that predicted by extrapolations of typical GSB-18 cathode performance to the temperature and operating conditions of the test. The performance of the cells with the experimental acids was also better at high current densities than the control cells but only slightly better than extrapolated predictions. It is probable that the acids were also helpful in wetting the catalyst layers. The operating slopes of all the cells were larger than expected (approx. 120 vs 90 mV/decade) for the operating conditions. This may be a result of the hydrophobicities of the catalyst layers. More testing would be required to be sure of the hypothesis. Author

**N91-32571#** Department of Energy, Washington, DC. Office of Industrial Technologies.
**OFFICE OF INDUSTRIAL TECHNOLOGIES RESEARCH IN PROGRESS**
Aug. 1991 72 p Prepared in cooperation with Department of Energy, Oak Ridge, TN
(DE91-014180; DOE/OSTI-11633-3) Avail: NTIS HC/MF A04

The U.S. Department of Energy (DOE) Office of Industrial Technologies (OIT) conducts industrial energy conservation research and development activities. Research and development efforts supported by OIT are directed at finding cost effective ways for U.S. industry to reduce energy consumption. OIT's mission is to (1) find, develop, and promote new technologies that improve energy efficiency and fuel flexibility, and (2) conduct research and development activities to develop methods to reduce waste generation, increase recycling, and improve the use of waste as process feedstocks in the industrial sector. To insure maximum program effectiveness, OIT works closely with U.S. industry to identify research and development needs. In addition, OIT-supported projects are typically funded on a cost shared or cooperative basis with the private sector. To encourage industrial implementation of energy conserving technologies, research and development efforts are supplemented with a variety of technology transfer activities and information exchanges. This report contains summaries for currently active projects supported by the Office of Industrial Technologies. The report was prepared from the DOE Research-in-Progress database maintained by the Office of Scientific and Technical Information. DOE

**N91-32572#** Lawrence Livermore National Lab., CA.
**ENERGY AND TECHNOLOGY REVIEW**
K. C. Johnson Apr. 1991 51 p
(Contract W-7405-eng-48)
(DE91-016873; UCRL-52000-91-4) Avail: NTIS HC/MF A04

This issue of Energy and Technology Review discusses the various educational programs in which Lawrence Livermore National Laboratory (LLNL) participates or sponsors. LLNL has a long history of fostering educational programs for students from kindergarten through graduate school. A goal is to enhance the teaching of science, mathematics, and technology and thereby assist educational institutions to increase the pool of scientists, engineers, and technicians. LLNL programs described include: (1) contributions to the improvement of U.S. science education; (2) the LESSON program; (3) collaborations with Bay Area Science and Technology Education; (4) project HOPES; (5) lasers and fusion energy education; (6) a curriculum on global climate change; (7) computer and technology instruction at LLNL's Science Education Center; (8) the National Education Supercomputer Program; (9) project STAR; (10) the American Indian Program; (11) LLNL programs with historically Black colleges and Universities; (12) the Undergraduate Summer Institute on Contemporary Topics in Applied Science; (13) the National Physical Science Consortium: A Fellowship Program for Minorities and Women; (14) LLNL's participation with AWU; (15) the apprenticeship programs at LLNL; and (16) the future of LLNL's educational programs. An appendix lists all of LLNL's educational programs and activities. Contacts and their respective telephone numbers are given for all these programs and activities. DOE

**N91-32573#** Los Alamos National Lab., NM.
**MODELING WATER CONTENT EFFECTS IN POLYMER ELECTROLYTE FUEL CELLS**
T. E. Springer, T. A. Zawodzinski, and S. Gottesfeld 1991 24 p Presented at the 180th Meeting of the Electrochemical Society, Phoenix, AZ, 13-18 Oct. 1991
(Contract W-7405-eng-36)
(DE91-016027; LA-UR-91-2338; CONF-911047-6) Avail: NTIS HC/MF A03

Water content and transport is the key factor in the one-dimensional, steady-state model of a complete polymer electrolyte fuel cell (PEFC) described here. Water diffusion coefficients, electroosmotic drag coefficients, water sorption isotherms, and membrane conductivities, all measured in our laboratory as functions of membrane water content, were used in the model. The model predicts a net-water-per-proton flux ratio of 0.2 H2O/H(sup +) under typical operating conditions, which is much less than the measured electroosmotic drag coefficient for a fully hydrated membrane. It also predicts an increase in membrane resistance with increased current density and demonstrates the great advantage of thinner membranes in alleviating this resistance problem. Both of these predictions were verified experimentally under certain conditions. We also describe the sensitivity of the water concentration profile and associated observables to variations in the values of some of the transport parameters in anticipation of applying the model to fuel cells employing other membranes. DOE

**N91-32574#** Sandia National Labs., Albuquerque, NM.
**DEVELOPMENT OF A STRETCHED-MEMBRANE DISH**
Jul. 1991 79 p Prepared in cooperation with Solar Kinetics, Inc., Dallas, TX
(Contract DE-AC04-76DP-00789)
(DE91-016499; SAND-90-7036) Avail: NTIS HC/MF A05

Solar Kinetics, Inc., successfully designed and constructed the optical element of a 7 m diameter stretched membrane dish as Task 2 of the second phase of a contract directed by Sandia National Laboratories. Earlier work on this project defined the configuration of the optical element and demonstrated the membrane forming process on 1.4- and 3.7 m diameter membranes. In Task 2, the membrane forming process was successfully scaled to 7 m in diameter, and an innovative hub-and-spoke structure optical element was fabricated. The slope error, as measured with Solar Kinetics' laser-ray-trace system, was within 3.6 mrad of a perfect parabola. Four major technical issues were successfully addressed in this work: (1) The technique of large-scale membrane forming was shown to be predictable, accurate, and repeatable. Three 7 m membranes were formed without any contoured tooling. (2) A tensioned hub-and-spoke structure was demonstrated to be practical to fabricate. This innovative structure, like a bicycle wheel, was shown to be very stiff. Optical effects from ring distortion were not apparent. (3) The use of field-replaceable, unattached polymer reflective membrane was demonstrated. This approach allows for the practical field replacement of the reflective membrane when it has degraded due to weathering. (4) A technique was developed and demonstrated to ship the formed membranes from the factory to the dish-installation site. This allows the critical forming of the membrane to be performed in a controlled factory environment, and the membrane then to be shipped using standard dimension shipping containers. This development further reduces manufacturing and installation costs of the completed dish. This effort indicates that the stretch membrane dish concept is a promising approach for solar concentration. The prototype optical element is a significant step in the development of the complete, full-sized dish. DOE

**N91-32575#** Midwest Research Inst., Golden, CO.
**SERI SOLAR RADIATION RESOURCE ASSESSMENT PROJECT**
C. Riordan, E. Maxwell, T. Stoffel, M. Rymes, and S. Wilcox Jul. 1991 56 p
(Contract DE-AC02-83CH-10093)
(DE91-002164; SERI/TP-262-4118) Avail: NTIS HC/MF A04

The purpose of the Solar Radiation Resource Project is to help meet the needs of the public, government, industry, and utilities for solar radiation data, models, and assessments as required to develop, design, deploy, and operate solar energy conversion systems. The project scientists produce information on the spatial (geographic), temporal (hourly, daily, and seasonal), and spectral (wavelength distribution) variability of solar radiation at different locations in the United States. Resources committed to the project in FY 1990 supported about four staff members, including part-time administrative support. With these resources, the staff must concentrate on solar radiation resource assessment in the United States; funds do not allow for significant efforts to respond to a common need for improved worldwide data. DOE

**N91-32576#** Pacific Northwest Lab., Richland, WA.
**SITE-SPECIFIC INVESTIGATIONS ON AQUIFER THERMAL ENERGY STORAGE FOR SPACE AND PROCESS COOLING**
D. R. Brown Aug. 1991 7 p Presented at the 26th Intersociety Energy Conversion Engineering (IECE) Conference, Boston, MA, 3-9 Aug. 1991
(Contract DE-AC06-76RL-01830)
(DE91-017534; PNL-SA-18872; CONF-910801-20) Avail: NTIS HC/MF A02

The Pacific Northwest Laboratory (PNL) has completed three preliminary site-specific feasibility studies that investigated aquifer thermal energy storage (ATES) for reducing space and process cooling costs. Chilled water stored in an ATES system could be used to meet all or part of the process and/or space cooling loads at the three facilities investigated. Seasonal or diurnal chill ATES systems could be significantly less expensive than a conventional electrically-driven, load-following chiller system at one of the three sites, depending on the cooling water loop return temperature and presumed future electricity escalation rate. For the other two sites investigated, a chill ATES system would be economically competitive with conventional chillers if onsite aquifer characteristics were improved. Well flow rates at one of the sites were adequate, but the expected thermal recovery efficiency was too low. The reverse of this situation was found at the other site, where the thermal recovery efficiency was expected to be adequate, but well flow rates were too low. DOE

**N91-32577#** Pacific Northwest Lab., Richland, WA.
**WIND ENERGY POTENTIAL IN THE UNITED STATES CONSIDERING ENVIRONMENTAL AND LAND-USE EXCLUSIONS**
D. L. Elliott, L. L. Wendell, and G. L. Gower 1991 7 p Presented at the World Congress of the International Solar Energy Society, Denver, CO, 19-23 Aug. 1991
(Contract DE-AC06-76RL-01830)
(DE91-017535; PNL-SA-19257; CONF-910802-1) Avail: NTIS HC/MF A02

In support of the U.S. Department of Energy's National Energy Strategy, estimates of the land area with various levels of wind energy resource have been developed for each state in the contiguous United States. The estimates are based on published wind resource data and account for the exclusion of some land owing to environmental or land-use considerations. These exclusions assume that 100 percent of the environmentally protected land and various percentages of land designated as urban, agricultural or range would be unavailable for wind energy development. Despite these exclusions, the amount of wind resource thus estimated is surprisingly large. For example, estimates of available wind resource and resultant wind electric potential from advanced turbine technology show that a group of 12 states in the midsection of the country could produce more than three times the nation's 1987 electric energy consumption. DOE

**N91-32578#** Akron Univ., OH. Dept. of Chemistry.
**DYNAMICS OF CHARGE-TRANSFER EXCITED STATES RELEVANT TO PHOTOCHEMICAL ENERGY CONVERSION**
E. C. Lim 1991 3 p
(Contract DE-FG02-89ER-14024)
(DE91-017710; DOE/ER-14024/2) Avail: NTIS HC/MF A01

This paper briefly discusses intramolecular photoassociation and photoinduced charge transfer in bridged diaryl compounds, and charge transfer interactions in the electronically excited stated of jet-cooled Van der Waals complexes. DOE

# 45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

**N91-32579*#** Southwest Research Inst., San Antonio, TX.
**SEPAC DATA ANALYSIS IN SUPPORT OF THE ENVIRONMENTAL INTERACTION PROGRAM Final Report, Nov. 1987 - Apr. 1991**
Chin S. Lin 31 Mar. 1991 52 p
(Contract NAS8-32488; SwRI Proj. 15-4865-009)
(NASA-CR-184201; NAS 1.26:184201) Avail: NTIS HC/MF A04 CSCL 13B

Data analyses of the Space Experiments with Particle Accelerators (SEPAC) data and computer modeling were conducted to investigate spacecraft environmental effects associated with injection of electron beams, plasma clouds, and neutral gas clouds from the Shuttle orbiter. The data analysis indicates that Extremely Low Frequency oscillations from 150 to 200 Hz were seen in the Langmuir probe current when the beam was fired in a continuous mode. The strongest oscillations occurred when the ambient pressure was augmented by neutral gas releases from the SEPAC plasma accelerator magnetoplasma-dynamic (MPD) arcjet. To understand the dependence of spacecraft charging potential on beam density and other plasma parameters, a two-dimensional electrostatic particle code was used to simulate the injection of electron beams from an infinite conductor into a plasma. The simulations show that the conductor charging potential depends critically on the reflection coefficient of the conductor surface, which is defined as the percentage of incident particles reflected by the conductor. The ionization effects on spacecraft charging were examined by including interactions of electrons with neutral gas. The simulations show that the conductor charging potential decreases with increasing neutral background density due to the production of secondary electrons near the conductor surface. The simulations also indicate that the beam radius is generally proportional to the beam electron gyroradius when the conductor is charged to a large potential. It appears that the charge buildup at the beam stagnation point causes the beam radial expansion. A survey of the simulation results suggests that the ratio of the beam radius to the beam electron gyroradius increases with the square root of beam density and decreases inversely with beam injection velocity. These results are useful for explaining the spacecraft charging phenomena observed during SEPAC experiments from Spacelab 1. Author

**N91-32580#** Institute of Oceanographic Sciences, Wormley (England).
**CHEMICAL TRACER STUDIES AT IOSDL-2: A METHOD MANUAL FOR THE ROUTINE MEASUREMENT OF CHLOROFLUOCARBONS IN SEAWATER AND AIR**
D. Smythe-Wright 1990 56 p
(IOS-275; ETN-91-99886) Avail: NTIS HC/MF A04; Institute of Oceanographic Sciences, Deacon Lab., Wormley, Gadalming, Surrey GU8 5UB, England, HC 18 sterling pounds

The Institute of Oceanographic Sciences Deacon Laboratory (IOSDL) recently built specially designed equipment for the shipboard measurement of chlorofluorocarbons in seawater and air. The use of this equipment and the necessary precautions for the collection and analysis of samples are explained. The analysis depends on a purge and trap technique followed by electron capture gas chromatography. ESA

**N91-32581#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany, F.R.). Forschungsbereich Energetik.
**NATURE AND TECHNOLOGY: ENERGY TECHNOLOGY, MANKIND, AND NATURE IN THE 21ST CENTURY**
Carl-Jochen Winter Feb. 1991 44 p In GERMAN; ENGLISH summary Presented at the Symposium der Evangelischen Akademikerschaft in Deutschland e.V. Welche Natur wollen wir? Welche Natur haben wir? Darmstadt, Fed. Republic of Germany, 18-21 Oct. 1990
(DLR-Mitt-91-05; ISSN-0939-298X; ETN-91-90033) Avail: NTIS HC/MF A03; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 15 DM

There is a chance to reconcile nature and technology in the 21st century, but technology will have to rely on fewer raw materials and use more closed loops, more technology, and greater financial investments. Technological expertise, a restructuring of the national economy to reflect ecological considerations, and the need for financing will be of primary importance. Those in the north will have to learn a new modesty so that the south too can have its share of the world's wealth. A turning away from political obstructionism at the end of the 20th century, at least in the north, national unification, and international integration can at best only temporarily obscure the fact that the paradigmatic flow of the world is headed in other directions. They point to nature, and to the south, which both call for finiteness in the number of people on Earth. ESA

**N91-32582#** Los Alamos National Lab., NM.
**QUALITY ASSURANCE OF FIELD SCREENING**
C. S. Leasure 1991 4 p Presented at the 18th Annual National Energy Division Conference on Quality Assurance of Field Screening, Boston, MA, 7-11 Oct. 1991
(Contract W-7405-eng-36)
(DE91-016303; LA-UR-91-2561; CONF-9110169-1) Avail: NTIS HC/MF A01

As the costs of collecting, shipping, and analyzing samples for environmental compliance have increased, ways of reducing those costs have been pursued, including field screening methods. Field personnel have long wanted methods that are portable, easy to use, sensitive for all regulated compounds and elements, and approved for use by all regulators. However, field methods do not currently meet these needs, and thus data quality for these methods

must be established. The proper amount of quality assurance on field screening methods cannot be easily standardized or prescribed for all field screening. Many field methods have not been documented sufficiently. To ensure that data of known quality is produced from field methods, the significant aspects of the operation of that method, including performance, must be determined and documented. The DOE's Laboratory Management Branch (EM-532) has initiated a program to assess the numbers and types of field methods both in the literature and available commercially. DOE

**N91-32583#** Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.

**PROCEEDINGS OF 2ND US/FRG WORKSHOP ON PHOTOCHEMICAL OZONE PROBLEM AND ITS CONTROL**

K. Becker, M. Gery, R. Derwent, A. Ebel, and H. Jeffries Jul. 1991 69 p Workshop held in Chapel Hill, NC, 5-8 Jun. 1990 Prepared in cooperation with Umweltbundesamt, Berlin (Fed. Republic of Germany)

(PB91-211847; EPA/600/9-91/020) Avail: NTIS HC/MF A04 CSCL 13B

The scope of the workshop was expanded, relative to the first workshop, to include subjects of interest to the Commission of European Communities and to the United Kingdom Department of the Environment. Specific topics include policy developments in the U.S. and Europe, atmospheric chemistry of organic pollutants, their relationships, the European Modeling and Evaluation Program (EMEP) photochemical ozone model and on-going research programs in Europe and the U.S. The Workshop Steering Committee offered recommendations for a third workshop in 1992 in Europe, for specific workshop topics, for joint U.S.-Europe studies, and for cooperative training programs. GRA

**N91-32584#** Naval Arctic Research Lab., Barrow (Alaska).

**NAVAL ARCTIC MANUAL, ATP 17(A)**

1991 354 p

(PB91-193920) Avail: NTIS HC/MF A16 CSCL 13B

The Naval Arctic Manual is intended to provide basic information to those engaged in Arctic operations who are unfamiliar with the environment and the operational problems associated with the environment. It is directed specifically towards the commanding officer at sea, and the operational planner ashore. Of prime interest are the factors which govern the accessibility of the Arctic Ocean and its peripheral seas, to ships. Considerable emphasis has therefore been placed, in the early chapters of the manual, on the subjects of climate, oceanography and ice, with particular reference to their interrelationship. This constitutes an area of vital concern to the Arctic sailor and the planner of Arctic operations. Author

**N91-32585#** Brookhaven National Lab., Upton, NY.

**SAMPLING OF ATMOSPHERIC CARBONYL COMPOUNDS FOR DETERMINATION BY LIQUID CHROMATOGRAPHY AFTER 2,4-DINITROPHENYLHYDRAZINE LABELLING**

A. Vairavamurthy, J. M. Roberts, and L. Newman Jun. 1991 45 p Presented at the Symposium on Measurement of Airborne Compounds: Sampling, Analysis, and Data Interpretation, Washington, DC, 26-31 Aug. 1990

(Contract DE-AC02-76CH-00016)

(DE91-015842; BNL-46240-Rev; CONF-9008162-2-Rev) Avail: NTIS HC/MF A03

Carbonyl compounds are both primary (directly emitted) and secondary (formed in situ) atmospheric species, which play a major role in tropospheric photochemistry. Because of trace concentrations (parts-per-billion and lower), ambient air measurements of carbonyls pose serious analytical problems. Generally, chromatographic approaches combined with chemical derivatization have been used to enhance sensitivity and selectivity in analysis. Currently, the liquid chromatographic method coupled to 2,4-dinitrophenylhydrazine derivatization (DNPH-LC) is in widespread use. Interferences arising from similar compounds are greatly minimized by chromatographic separation; however, those in the air sampling step, especially with ozone, continue to be problematic and remain to be resolved. We discuss here the different sampling techniques used for time-integrated collection of carbonyls in the DNPH-LC methods. Emphasis is placed on addressing: (1) the principles, advantages, and limitations of sampling techniques; (2) problems associated with reagent blank and sampling instrument; and (3) effects of atmospheric co-pollutants, especially ozone. DOE

**N91-32586#** California Univ., Berkeley. Lawrence Berkeley Lab.

**A GUIDEBOOK FOR THE CONTROL OF SUMMER HEAT ISLANDS**

J. Huang, S. Davis, and H. Akbari Aug. 1990 14 p Presented at the ACEEE Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA, 26 Aug. - 1 Sep. 1990

(Contract DE-AC03-76SF-00098)

(DE91-016246; LBL-29224; CONF-900833-16) Avail: NTIS HC/MF A03

The Heat Island Project at Lawrence Berkeley Laboratory (LBL/HIP) is compiling a guidebook for the control of summer heat islands, which currently affect most U.S. cities. The guidebook will describe the causes and societal costs of this climate phenomenon, as well as the benefits and energy saving potentials of using trees and light-colored surfaces to mitigate it. Both conservation potentials and the experiences of city-wide implementation programs will be presented. The guidebook is supported by the Environmental Protection Agency (EPA), Electric Power Research Institute (EPRI), and others. It is written in non-technical language, and targeted for government officials, utility planners, and others interested in addressing this community-wide energy and environmental issue. The manual is scheduled for completion by the Fall of 1990, but will be updated periodically as new information becomes available. DOE

**N91-32587#** San Diego State Univ., CA.

**MODELING THE RESPONSE OF PLANTS AND ECOSYSTEMS TO GLOBAL CHANGE**

J. F. Reynolds, P. Harley, D. W. Hilbert, and P. R. Kemp 1 Jun. 1991 57 p

(Contract DE-FG03-86ER-60490)

(DE91-017403; DOE/ER-60490/T1) Avail: NTIS HC/MF A04

Complex global changes, such as elevated atmospheric CO2, are difficult to address because they require translating information across many spatial and temporal scales. While the direct effects of a change may be focused at a single scale, ramifications of the change may be seen at higher and lower scales. Understanding these interactions and predicting them requires modeling, but a single model cannot be expected to span all scales. Our aim has been to develop a hierarchy of models, each suited to a particular scale, that receive information from lower levels and provide input to higher level models. GEPSI, our GEneric Plant SImulator, models responses at the level of leaves, canopies, resource allocation and plant/plant interactions, while SERECO adds soil and atmospheric environments. DOE

**N91-32588#** Lawrence Livermore National Lab., CA.

**IMPACT OF REACTIVE NITROGEN EMISSIONS FROM FOSSIL FUEL COMBUSTION AND BIOMASS BURNING ON ATMOSPHERIC CHEMISTRY**

J. Dignon, J. E. Penner, C. S. Atherton, and J. J. Walton Jul. 1991 28 p Presented at the International Symposium on Energy and Environment, Espoo, Finland, 25-28 Aug. 1991

(Contract W-7405-eng-48)

(DE91-017651; UCRL-JC-108038; CONF-910809-2) Avail: NTIS HC/MF A03

The increasing desire for energy in our society has caused changes in our environment. One of the byproducts of energy consumption is the emission of nitrogen oxides from combustion processes. Nitrogen oxides play an important role in atmospheric chemistry on local, regional, and global scales. They are considered primary pollutants which can chemically react and contribute to photochemical smog. They are also precursors to the chemical

formation of nitric acid (HNO3). Nitric acid is a major contributor to acidic deposition, more commonly referred to as acid rain. Reactive nitrogen is also a major limiting nutrient in some soil and ocean ecosystems. NO(x) is also important because it interacts with other trace gases in the atmosphere. In this study, using a Lagrangian chemical-transport-deposition model adapted to the nitrogen cycle, we will look at all of the known sources, both natural and man-made. We will attempt to quantify the relative affect that man-made sources including fossil fuel and biomass burning have had on the nitrogen cycle and the chemistry of the atmosphere throughout the globe. DOE

**N91-32589#** Lawrence Livermore National Lab., CA.
**GEOENGINEERING THE CLIMATE**
Michael C. MacCracken 18 Jun. 1991 15 p Presented at the Workshop on the Engineering Response To Global Climate Change, Palm Coast, FL, 1-6 Jun. 1991
(Contract W-7405-eng-48)
(DE91-017654; UCRL-JC-108014; CONF-9106267-1) Avail: NTIS HC/MF A03

Although much can be done to limit greenhouse gas emissions by conservation, improvements in efficiency, and use of alternative technologies, the use of fossil fuels at rates even sharply reduced from U.S. per capita values will lead to rapidly increasing global concentrations of greenhouse gases. The available alternatives then become adapting to the changes, switching to alternative energy sources (e.g., solar, nuclear), or actively taking control of atmospheric composition and/or the climate. This note reviews options for geoengineering the climate. DOE

**N91-32590#** Los Alamos National Lab., NM.
**MEXICO CITY AIR QUALITY RESEARCH INITIATIVE: AN OVERVIEW AND SOME STATISTICAL ASPECTS**
R. A. Waller, G. E. Streit, and F. Guzman 1991 19 p Presented at the 3rd Interamerican Seminar on Applied Statistics Applications of Statistics in Business and Actuarial Science, Mexico City, Mexico, 24-27 Sep. 1991
(Contract W-7405-eng-36)
(DE91-018045; LA-UR-91-2762; CONF-9109249-1) Avail: NTIS HC/MF A03

The Mexican Petroleum Institute (Institute Mexicano del Petroleo, IMP) and Los Alamos National Laboratory (LANL) are in the first year of a three-year jointly funded project to examine the air quality in Mexico City and to provide techniques to evaluate the impact of proposed mitigation options. The technical tasks include modeling and simulation; monitoring and characterization; and strategic evaluation. Extensive measurements of the atmosphere, climate, and meteorology are being made as part of the study. This presentation provides an overview of the total project plan, reports on the current status of the technical tasks, describes the data collection methods, presents examples of the data analysis and graphics, and suggest roles for statistical analysis in this and similar environmental studies. DOE

**N91-32672*#** Florida State Univ., Tallahassee. Geophysical Fluid Dynamics Inst.
**POTENTIAL VORTICITY INDEX**
Albert Barcilon and Hengyi Weng *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 37-39 (For primary document see N91-32660 24-47)
(Grant NAG8-760)
Avail: NTIS HC/MF A05 CSCL 13B

**N91-32679*#** National Oceanic and Atmospheric Administration, Boulder, CO.
**NOAA BACKSCATTER STUDIES**
Madison J. Post *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 57-59 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 13B

# 46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

**N91-32591*#** Nevada Univ., Reno. School of Mines.
**NATURE AND ORIGIN OF SECONDARY MINERAL COATINGS ON VOLCANIC ROCKS OF THE BLACK MOUNTAIN, STONEWALL MOUNTAIN, AND KANE SPRINGS WASH VOLCANIC CENTERS, SOUTHERN, NEVADA**
James V. Taranik, Liang C. Hsu, David M. Spatz, and Michael J. Chenevey Oct. 1989 621 p Original contains color illustrations
(Contract NAS5-28765)
(NASA-CR-183493; NAS 1.26:183493) Avail: NTIS HC/MF A99; 54 functional color pages CSCL 08G

The following subject areas are covered: (1) genetic, spectral, and LANDSAT Thematic Mapper imagery relationship between desert varnish and tertiary volcanic host rocks, southern Nevada; (2) reconnaissance geologic mapping of the Kane Springs Wash Volcanic Center, Lincoln County, Nevada, using multispectral thermal infrared imagery; (3) interregional comparisons of desert varnish; and (4) airborne scanner (GERIS) imagery of the Kane Springs Wash Volcanic Center, Lincoln County, Nevada. Author

**N91-32592#** National Inst. for Fusion Science, Nagoya (Japan).
**A GLOBAL SIMULATION OF THE MAGNETOSPHERE WITH A LONG TAIL: SOUTHWARD AND NORTHWARD IMF**
A. Usadi, A. Kageyama (Hiroshima Univ., Japan ), K. Watanabe, and T. Sato Jun. 1991 35 p Original contains color illustrations
(NIFS-99; ISSN-0915-633X) Avail: NTIS HC/MF A03; 1 functional color page

Through a global three dimensional magnetohydrodynamic simulation, the effect of the Interplanetary Magnetic Field (IMF), both northward and southward, on Earth's magnetosphere was investigated. A southward IMF, upon reconnecting at the dayside magnetopause of the Earth's magnetic field is swept back by solar wind flow and drapes the magnetotail. This gives rise to a plasma sheet cross-tail current increase and explosive magnetic reconnection at around 15 R sub E. This reconnection results in the formation of a large plasmoid which grows much faster than for the simulation with no IMF, thus supporting, in a convincing way with a minimum of assumptions, previous notions that a southward IMF is a driving mechanism of plasma sheet reconnection. A northward IMF is observed to reconnect with the magnetosphere along the cusp shoulder, stripping magnetic field lines away and weakening compression of the plasma sheet. In order to accommodate a balance of magnetic to dynamic pressure along the magnetopause, the magnetosphere changes from its usual comet-like shape to that resembling a tadpole as it attempts to return to a dipolar structure. Author

**N91-32593** Cincinnati Univ., OH.
**ON THE NONLINEAR RESPONSE OF MINOR ATMOSPHERIC SPECIES TO LINEAR GRAVITY WAVES Ph.D. Thesis**
Joseph R. Isler 1990 125 p
Avail: Univ. Microfilms Order No. DA9119983

Many of the observations of the motion of the middle and upper atmosphere rely upon detecting minor atmospheric constituents. Due to their steep vertical density gradients, the response of some minor species to small-amplitude perturbations may be nonlinear even when the perturbing motion of the atmosphere as a whole can be treated linearly. A method is developed by which some of the nonlinear effects in the response of such minor species may be calculated. Particular emphasis is given to the case when the perturbing motion of the atmosphere as a whole is that of a monochromatic linear gravity wave. Dissert. Abstr.

**N91-32594#** Connecticut Univ., Groton. Marine Sciences Inst.
**HELIUM ISOTOPIC CONSTRAINTS ON TERRESTRIAL DEGASSING AND THE TRANSCRUSTAL TRANSPORT OF MANTLE METHANE Final Report, Jul. 1987 - Dec. 1990**
T. Torgersen Jan. 1991 190 p
(Contract GRI-5087-260-1613)
(PB91-206458; GRI-91/0138) Avail: NTIS HC/MF A09 CSCL 08G

The large scale transport of crustal gases using helium (and argon) isotopes is addressed. The flux of helium and argon through the continental crust is roughly equivalent to the whole crustal production. The flux of mantle helium and carbon in the absence of volcanism is minimal. The mean transport coefficient of the continental crust must be greater than 0.00001 sq cm/s with rates as high as 0.001 sq cm/s measured. This mass transport must have advective controls. The Cajon Pass drillhole results conclusively support episodic mass transport as a dominate mechanism in agreement with the results of numerous metamorphic studies. The He, Ar, He/Ar, and N2 in natural gas and the GAB suggests a decoupling of the degassing fluxes which may be accounted for by fracturing release and episodic mass transport. This episodic mass transport is likely to have both mechanical and tectonic controls as well as a fracturing control component. In the case of natural gas deposits, it is likely that a N2 carrier phase exists. Author

**N91-32595** Alaska Univ., Fairbanks.
**A STUDY OF THE MAGNETOSPHERE-IONOSPHERE COUPLING PROCESSES Ph.D. Thesis**
Lie Zhu 1990 156 p
Avail: Univ. Microfilms Order No. DA9121906

Magnetosphere-ionosphere (M-I) coupling processes are studied by using numerical modeling. An M-I coupling model of substorms on the ionospheric recombination time scale (tens of seconds) is developed. The model is 2-D and time dependent from which several signatures of substorms can be obtained and understood. The model is then extended to northward interplanetary magnetic field (IMF) conditions to study the effects of the M-I coupling on the high-latitude convection. Based on the model results, a mechanism for the origin of distorted two-cell ionospheric convection is proposed. The ionospheric and ground signatures of multiple field-aligned current sheets originating from dayside flux transfer events were modeled. The interaction between Alfven waves and field aligned potential drops is studied by using a local model. Author

**N91-32596** Deutscher Wetterdienst, Offenbach am Main (Germany, F.R.).
**TURBULENT ENERGY EXCHANGE BETWEEN ATMOSPHERE AND SURFACE LAYER. METHODOLOGY, MEASURING TECHNICAL REALIZATIONS, THEIR LIMITS, AND POSSIBLE USES [TURBULENTER ENERGIEAUSTAUSCH ZWISCHEN ATMOSPHAERE UND UNTERLAGE: METHODEN, MESSTECHNISCHE REALISIERUNG SOWIE IHRE GRENZEN UND ANWENDUNGSMOEGLICHKEITEN]**
Thomas Foken (Meteorologischer Dienst der DDR, Potsdam, German D.R. ) 1990 281 p In GERMAN; ENGLISH summary
(ISBN-3-88148-263-6; ISSN-0072-4130; ETN-91-90015)
Copyright Avail: Deutscher Wetterdienst, Frankfurter Strasse 135, D-6050 Offenbach am Main, Fed. Republic of Germany

Measurements were performed during a period of more than ten years, on turbulent energy exchange, e.g., momentum flux and latent heat flux. A summary of the methods and its problems is given, e.g., the application of different methods, measuring devices and their errors. It is shown that the error of energy exchange measurements is about ten to twenty percent depending on the parameter, the scale, the terrain, the method and the devices used. ESA

**N91-32597#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
**THE PHYSICS AND INSTRUMENTATION OF PASSIVE ATMOSPHERIC SOUNDING: A REVIEW OF THE METHODS OF REMOTE SENSING OF TEMPERATURE AND MOISTURE IN THE EARTH'S LOWER ATMOSPHERE**
Paul Ingmann and W. R. Burke, ed. Jul. 1991 61 p
(ESA-STR-231; ISBN-92-9092-192-7; ISSN-0379-4067; ETN-91-30072) Copyright Avail: NTIS HC/MF A04

A review of methods of passive remote sounding of the Earth's lower atmosphere is presented. Emphasis is placed on the instruments now in operation in space. Details of the instruments' construction, their performance and the validation of the data they provide are given. Early sensors are discussed. A chronology of the sensors flown which shows the technical evolution of passive atmospheric sounding instrumentation for meteorological purposes is given. Starting from the early days (test satellites in polar orbit), present systems are addressed, (satellites in polar orbit and satellites in geostationary orbit). The future prospects of atmospheric sounding are discussed. A presentation of most likely future scenarios, where both passive and active sensors are considered, is given. ESA

**N91-32529*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**SCIENCE ISSUES**
*In its* International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 1-10 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32530*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**MEASUREMENTS**
*In its* International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 11-25 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32531*#** Environmental Protection Agency, Research Triangle Park, NC.
**ANNULAR DENUDERS FOR USE IN GLOBAL CLIMATE AND STRATOSPHERIC MEASUREMENTS OF ACIDIC GASES AND PARTICLES Abstract Only**
Robert K. Stevens *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 41 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32532*#** Kansas Univ., Lawrence. Dept. of Civil Engineering.
**ANNULAR DENUDER SYSTEMS: PRECISION AND APPLICABILITY TO STRATOSPHERIC SAMPLING**
Stephen J. Randtke and Dennis D. Lane *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 42-46 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32533*#** Desert Research Inst., Reno, NV.
**LABORATORY AND FIELD STUDIES OF STRATOSPHERIC AEROSOLS: PHASE CHANGES UNDER HIGH SUPERSATURATION Abstract Only**
John Hallet *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 47 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32534*#** Wyoming Univ., Laramie. Dept. of Physics and Astronomy.
**MEASUREMENTS IN POLAR STRATOSPHERIC CLOUDS OVER ANTARCTICA IN SEPTEMBER 1989 Abstract Only**
Terry Deshler *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 48 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32535*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**VALIDATION OF LIDAR AND SATELLITE REMOTE SENSING Abstract Only**
M. P. McCormick *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 49 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32536*#** Fraunhofer-Inst. fuer Atmosphaerische Umweltforschung, Garmisch-Partenkirchen (Germany, F.R.).
**LIDAR MEASUREMENTS AT GARMISCH, CONVERSION MODEL, AND MIDLATITUDE AEROSOL EFFECTS Abstract Only**
Horst Jaeger *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 50 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32537*#** Consiglio Nazionale delle Ricerche, Florence (Italy). Ist. di Ricerca sulle Onde Elettromagnetiche.
**POLAR STRATOSPHERIC CLOUD MEASUREMENTS BY MEANS OF DEPOLARIZATION LIDAR IN THE ANTARCTIC Abstract Only**
L. Stefanutti *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 51-53 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32538*#** Universite des Sciences et Techniques de Lille (France). Lab. d'Optique Atmospherique.
**AEROSOL SENSING FROM BALLOONS USING PHOTOPOLARIMETRY Abstract Only**
R. Santer, B. S. Diallo, and M. Herman *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 56 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32539*#** Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
**THE EFFECTS OF SULFATE AND SOOT IN SMOKE ON ATMOSPHERIC EXTINCTION Abstract Only**
Weihan Su *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 57 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32540*#** Academia Sinica, Hefei (China). Inst. of Optics and Fine Mechanics.
**A LIDAR EQUIPPED WITH PHOTON COUNTER FOR MEASURING STRATOSPHERIC AEROSOLS Abstract Only**
Jun Zhou and Huanling Hu *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 59 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32541*#** Kernforschungszentrum G.m.b.H., Karlsruhe (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik.
**IN SITU MEASUREMENTS OF LIGHT EXTINCTION OF STRATOSPHERIC AEROSOLS Abstract Only**
Gunthard Metzig *In* NASA. Ames Research Center, International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects Feb. 1991 p 59 (For primary document see N91-32528 24-43)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32673*#** California Univ., Davis. Atmospheric Science Program.
**USE OF SATELLITE DATA AND MODELING TO ASSESS THE INFLUENCE OF STRATOSPHERIC PROCESSES ON THE TROPOSPHERE**
Terrence Nathan *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 41-43 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32687*#** Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
**NONLINEAR DYNAMICS OF GLOBAL ATMOSPHERIC AND EARTH-SYSTEM PROCESSES**
Barry Saltzman, Wesley Ebisuzaki, Kirk A. Maasch, Robert Oglesby, and Lionel Pandolfo *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 83-84 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04A

**N91-32692*#** Purdue Univ., West Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
**SYNOPTIC/PLANETARY-SCALE INTERACTIONS AND BLOCKING OVER THE NORTH ATLANTIC OCEAN**
Phillip J. Smith, Mary A. Uhl, Anthony R. Lupo, Gregory L. Lamberty, and Melinda Hunter *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 101-102 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04A

# 47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

**N91-32598#** World Meteorological Organization, Geneva (Switzerland).
**REPORT OF THE EXPERT GROUP ON GLOBAL BASELINE DATASETS World Climate Data Programme**
Jan. 1990 91 p Meeting held in Asheville, NC, 22-26 Jan. 1990
(WCDP-11; WMO/TD-359) Avail: NTIS HC/MF A05; print copy available at WMO, Geneva

The goal for this project was to construct global data sets available to all members and researchers that can be used and accepted as the official data set for climate change studies. The experts considered that the construction of the baseline data set should have both long term and short term goals. The starting point for achieving the goal was first to state the requirements as seen by the experts. It was pointed out that approx. 1200 stations currently send CLIMAT reports via the GTS, with approx. 2000 station being published each decade as part of the World Weather Records. The expert group also fully endorse the WMO recommendations to increase the number of CLIMAT reporting stations and to include additional parameters in the CLIMAT messages. Author

**N91-32599*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
**THE 1991 INTERNATIONAL AEROSPACE AND GROUND CONFERENCE ON LIGHTNING AND STATIC ELECTRICITY, VOLUME 1**
Aug. 1991 626 p Conference held in Cocoa Beach, FL, 16-19 Apr. 1991; sponsored in part by NASA, the National Interagency Coordination Group, and Florida Inst. of Tech.
(NASA-CP-3106-Vol-1; NAS 1.55:3106-Vol-1) Avail: NTIS HC/MF A99 CSCL 04B

The proceedings of the 1991 International Aerospace and Ground Conference on Lightning and Static Electricity are reported. Some of the topics covered include: lightning, lightning suppression, aerospace vehicles, aircraft safety, flight safety, aviation meteorology, thunderstorms, atmospheric electricity, warning systems, weather forecasting, electromagnetic coupling, electrical measurement, electrostatics, aircraft hazards, flight hazards, meteorological parameters, cloud (meteorology), ground effect, electric currents, lightning equipment, electric fields, measuring instruments, electrical grounding, and aircraft instruments. For individual titles, see N91-32600 through N91-32658.

**N91-32600*#** National Severe Storms Lab., Norman, OK.
**LIGHTNING THREAT TO AIRCRAFT: DO WE KNOW ALL WE NEED TO KNOW? c03**
Vladislav Mazur *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 8 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

The problem of lightning threat to aircraft has two aspects: strike avoidance and aircraft protection. These two issues are addressed under the following topics: (1) lightning strikes, weather conditions, and natural lightning rate; (2) the engineering vs. scientific approach to aircraft protection; and (3) the additional information needed to understand lightning threat to aircraft.
K.S.

**N91-32601*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**DESCRIPTION AND INTERPRETATION OF AIRCRAFT LIGHTNING ATTACHMENT ELECTRIC AND MAGNETIC FIELD MEASUREMENTS AND VIDEO OBSERVATION c03**
J. P. Moreau and S. Larigaldie *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

In 1988, ONERA carried out a complete airborne lightning characterization program. Among other features, the program has provided a significant amount of data from analog records of electric and magnetic field sensors to give a description of all stages of the lightning process. The initiation phase has a description of all stages of the lightning process. The initiation phase has been described in the past, so the present objective is to give a description of the other stages of the discharge, based on the observation of analog electromagnetic waveforms and of fast video (200 f/s) image processed pictures. During lightning attachment, the aircraft remains electrically connected to the lightning channel where a large variety of physical processes occur. These physical processes include recoil streamers, return strokes, and even other initiation processes of secondary discharges. Typical records of analog electromagnetic field along with relative luminosity variation of the channel, which shows that there is no extinction of the continuous current throughout the discharge process. A computation of current and potential waveforms using the transmission line formalism is presented and gives satisfactory results for the representation of two of the typical waveforms observed in the recoil streamer processes. Author

**N91-32602*#** National Severe Storms Lab., Norman, OK.
**INTRACLOUD DEVELOPMENT OF LIGHTNING STRIKES TO AIRCRAFT c03**
Vladislav Mazur *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
(Contract DTFA03-87-A-00021)
Avail: NTIS HC/MF A99 CSCL 01C

The analysis of airborne electromagnetic records of seven lightning strikes to the FAA CV-580 instrumented airplane during the 1987 field campaign was aimed at revealing and interpreting processes taken place during the intracloud propagation of lighting strikes initiated on or intercepted by the airplane. It is shown that intracloud development of the strike may consist of recoil streamers, dart leader/return stroke sequences, and the secondary initiations of new discharges. These processes, with their high current pulse amplitudes, may present greater threat to aircraft than current pulses during strike initiation. The latter are presently considered by the technical community to be the primary lightning threat to aircraft. Author

**N91-32603*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**CURRENT WAVE-FORM OBSERVED DURING LIGHTNING STRIKES ON AIRCRAFT**
J. L. Boulay *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 12 p Previously announced in IAA as A91-45610 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

A preliminary validation of a number of mechanisms that can be associated with the various phases encountered during in-flight lightning strikes are provided. It is known that a lightning strike on an aircraft occurs in several phases: a preparation phase, an electric arc attachment phase, a connection phase, and a re-light phase. This analysis is confined to the study of the readings obtained during the electric arc attachment phase and to experiments carried out to validate the scenarios that are currently understood. The objective of the analysis is to explain this attachment phase. A brief review of the experiments that are currently being performed in an attempt to understand the re-light phase is also presented. Author

**N91-32604*#** Rockwell International Corp., Downey, CA. Space Systems Div.
**LIGHTNING CURRENT RATE OF RISE IN THE NEW LIGHTNING FLASH MODEL FOR THE SPACE SHUTTLE PROGRAM c16**
Nathaniel G. Bankston *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 14 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 22B

The recently baselined Space Shuttle lightning effects flash model is discussed. The discussion is limited to the current rate(s) of rise. A review of some of the recent data is presented, as well as a discussion of how interaction processes affect the induced voltages and currents which arise from a lightning strike. It is concluded that the multiple pulse components of the new flash model present a more severe threat to complex avionic systems, than is presented by a single pulse having an extremely fast rate of rise. Author

**N91-32605*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**MODELING OF ELECTRICALLY THICK MATERIALS THEORETICAL AND EXPERIMENTAL ASPECTS c24**
V. Gobin, F. Issac, and F. Jaillot *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced in IAA as A91-45609 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 11D

The shielding effectiveness of modern aircraft depends upon

the nature and the electromagnetic properties of the materials used. It was shown that thin materials are modeled well by a sheet surface impedance. Unfortunately, this formalism fails in the high frequency domain (when skin effect occurs) and when the materials are physically thick. The purpose is to propose a general formalism that renders the skin effect and can be used with multilayered samples. These electrically thick materials are studied using symmetrical boundary conditions applied to tangential fields. The domain of validity of the method is discussed and experimental validations are presented. Author

**N91-32606*#** United Kingdom Atomic Energy Authority, Abingdon (England). Lightning Test and Technology.

**INVESTIGATIONS INTO THE DAMAGE FOR VARIOUS TYPES OF UNPROTECTED CARBON FIBRE COMPOSITES WITH A VARIETY OF LIGHTNING ARC ATTACHMENTS c24**

G. W. Reid *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p (For primary document see N91-32599 24-47)

Avail: NTIS HC/MF A99 CSCL 11D

Very little quantitative information exists on the extent and nature of damage caused to unprotected carbon fiber composites (CFC's) due to lightning arc attachment. An initial investigation into the arc damage to three different types and various thickness of CFC's from A and C component type lightning discharges is described. The difference in damage which the two types of waveform produced and the way the area of damage varies with different levels of action integral and charge transfer is compared. In some cases, the temperature rise at the rear of the panels was recorded for various levels of action integral and charge transfer. A comparison was made of the area of damage from visual inspection and soft x ray photography, using a suitable penetrant in the damage area. It is concluded there is a need for a more detailed analysis of the damage. Author

**N91-32607*#** Tohoku Univ., Sendai (Japan).

**CHARACTERISTICS OF WINTER LIGHTNING CURRENTS STRUCK AN ISOLATED TOWER**

Yukihiro Goto, Kenichi Narita, and Hiroshi Komuro (Tohoku Electric Power Co., Inc., Sendai, Japan ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)

Avail: NTIS HC/MF A99 CSCL 04B

To make clear the characteristics of winter lightning flashes, the current waveforms of winter lightning flashes were measured by two resistive shunts which were connected to two lighting rods since the winter of 1981, and another measurement has started using a set of five Rogowsky type coils since the winter of 1982. They were recorded by computer controlled digital recording systems. Up to date, 145 current waveforms of the winter lightning flashes, which have the current amplitude over 1 kA, were obtained by the shunt systems and/or the coils system. They show that winter lightning flashes often have a very long duration or continuing current and sometimes have a very large amplitude over 200 kA in positive flashes. For example, the current parameters that were measured on 9 Jan. 1987 were the maximum current amplitude, +280 kA, maximum current derivative 1.0 x 10(exp 10) A/s, total charge +400 C, and action integral 1.5 x 10(exp 7)(sq. A)(s). The statistical evaluation shows that medium peak values of winter lightning flashes (50 percent values) were about 5 kA for negative and 10 kA for positive, and 5 percent values were about 30 kA for negative and 170 kA for positive. The winter lightning current waveforms are classified into three types: single stroke flashes, monopolar multistroke flashes, and bipolar flashes. Moreover, each flash is subdivided into positive or negative, single peak or multipeak, and with or without continuing current. Author

**N91-32608*#** Airborne Research Associates, Weston, MA.

**THUNDERSTORM DETECTION AND WARNING SYSTEM ATMOSPHERIC POTENTIAL MONITOR**

*In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 8 p (For primary document see N91-32599 24-47)

Avail: NTIS HC/MF A99 CSCL 04B

An new type of electric field instrumentation was developed for lighting prediction at KSC. Currently, it is being installed at several government laboratories and is being made available to the public. It has important advantages over the previous method for measuring electric fields with motor driven field mills: (1) it has no moving parts and requires little maintenance compared to rotating machinery; (2) it is unaffected by rain, snow, sand, or insects, all of which can influence field mills; and (3) the lightweight sensor can be mounted easily on a tall mast. By mounting the instrumentation on a tall mast the instrumentation is placed above much of the blanket of point discharge ions that are emitted from objects on the ground during thunderstorms. This space charge limits the ability of any ground based electric field sensor to accurately measure cloud electric fields which produce lightning. The elevated mounting was demonstrated to significantly improve monitoring of thunderstorm electric fields. This instrumentation measures the atmospheric potential relative to earth at a corona needle sensor on top of a mast which normally is mounted on a tower or roof. The needle is kept in corona at all times by a low power high voltage power supply. This produces a small cloud of ions around the needle allowing a current to flow. Measurement of the current provides the atmospheric potential. The potential divided by the height of the needle above the ground is proportional to the average electric field between the needle and earth. The potential on top of a tall pole or above a rooftop is more representative of the intensity of cloud electrification than electric field measurements made at ground level. Photographs that depict the computer terminal, video display of a two sensor system, and the individual components installed on a tower are presented.

Author

**N91-32609*#** New Mexico Inst. of Mining and Technology, Socorro. Lab. for Atmospheric Research.

**ELECTRICAL EMISSIONS OF AIRPLANES FLYING IN ELECTRIFIED CLOUDS AND THEIR EFFECT ON AIRPLANE MEASUREMENTS OF CLOUD ELECTRIC FIELDS**

James J. Jones *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p Sponsored in part by Navy (For primary document see N91-32599 24-47)

(Grants NAG8-751; NSF ATM-82-05468; NSF ATM-82-18621; NSF ATM-86-00526; NSF ATM-89-19697)

Avail: NTIS HC/MF A99 CSCL 04B

The signature of the cloud electric field components deduced from measurements made with electric field meters carried on airplane penetrating electrified clouds is often complex, especially when the airplane experiences strong electrical charging. However, simple electric field variations were obtained for penetrations involving severe charging of the airplane on flights over KSC on 19 Aug. 1989. During these episodes of severe electrical charging, the airplane typically became negatively charged as it approached a region of negative cloud charge and then became positively charged as it receded from the cloud charge. The charge acquired by the airplane within the cloud was so large that the electric fields at the faces of the mills mounted on the fuselage were as large as for an ambient electric field of 60 to 80 kV/m. However, the deduced electric field components perpendicular to the direction of flight, to which these mills respond, were only about 5 to 10 kV/m. The variation of the deduced ambient field component in the direction of flight was antisymmetric about the charge region for these penetrations. Analysis of these results suggest that intense plumes of electric charge were emitted from the airplane and that the electric field associated with these plumes overcame the electric field due to the cloud charge at the tail-mounted field mill. As a consequence, the deduced component of the ambient electric field in the direction of flight was severely distorted. These findings emphasize the need for careful evaluation of airplane electric field measurements and of the need for further work on techniques for improving the measurements. Author

**N91-32610*#** Florida Univ., Gainesville. Dept. of Electrical Engineering.

**E AND DE/DT WAVESHAPES FOR NARROW BIPOLAR PULSES IN INTRACLOUD LIGHTNING**

Pedro J. Medelius, Ewen M. Thomson, and J. S. Pierce *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)

(Grants NAL10-0049; AF-AFOSR-0093-91)

Avail: NTIS HC/MF A99 CSCL 04B

Wideband electric field and dE/dt waveforms were recorded and digitized at a 100 MS/s rate at KSC during the summer and fall of 1989. These waveforms were combined to produce composite electric fields with an effective bandwidth of 3 to 50 MHz. Bipolar electric field pulses are characterized in terms of their E and dE/dt waveshapes. Half width mean durations were found to be 1.83 and 3.64 microseconds for negative and positive bipolar pulses respectively. Twenty of thirty of these pulses were found to occur independently of any other lightning activity. Analysis of the frequency content of these pulses as a function of time shows that radiation at different frequencies peak at different times. In addition to the initial peak and subsequent overshoot in the composite E waveshape, secondary humps following the initial peak are characterized according to their time of occurrence within the pulse. THe 156 narrow negative bipolar pulses and 10 positive narrow bipolar pulses are analyzed. The dE/dt signatures range from impulsive variations lasting several microseconds both before and after the initial peak of the electric field pulse, to smoother variations closely associated with peak. Author

**N91-32611*#** Raychem Ltd., Swindon (England).

**THE PERFORMANCE OF CABLE BRAIDS AND TERMINATIONS TO LIGHTNING INDUCED TRANSIENTS c03**

David Crofts *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)

Avail: NTIS HC/MF A99 CSCL 01C

The latest specification detailing the test waveforms for indirect lightning transients as applied to aircraft wiring systems specify very high voltages and currents. Although considerable data exists for measuring cable screen leakage using such methods as surface transfer impedance and bulk cable injection, there is little data on the likely core transient level that is likely to be induced from these threats. In particular, the new Waveform 5 at very high current levels (10 kA) is reputed to cause severe cable damage. A range of representative cables were made with various screen termination techniques and screening levels. These were tested first to determine their relative screening performance and then they were subjected to lightning transient testing to all the specified waveforms. Core voltages were measured for each test. Tests were also performed on bundles with fewer wires to determine the failure criteria with Waveform 5 and these tests also include flat conductor cables. The test showed that correctly terminated cable bundles performed well in all the tests and would provide a high level of protection to the electronic systems. The use of overbraides, provided the individual screens are well terminated, appears to be unnecessary. Author

**N91-32612*#** Fokker Space and Systems, Amsterdam (Netherlands).

**LIGHTNING PROTECTION OF THE FOKKER 100 CFRP RUDDER c03**

A. J. M. Ruiter *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)

Avail: NTIS HC/MF A99 CSCL 01C

The construction of the structural parts of the Fokker 100 CFRP rudder is described with respect to the requirements for electrical bonding and lightning protection. Furthermore, the philosophy for the selection of a consumable trailing edge is given. A description of possible alternative designs for trailing edges and their advantages and disadvantages with respect to damage after lightning impact will also be reviewed. An overview of the tests performed on test samples and the rudder construction are presented and discussed. The effectiveness of both the selected structural provisions and trailing edge are described (and proven) by reporting the results of the simulated lightning tests performed. Proof is given that the trailing edge construction and its bonding through the structural parts of the rudder to the main aircraft structure is a solution which results in minor damage to the rudder after lightning impact. Furthermore, it is shown that the selected trailing edge construction is less favored by the structural designers due to the weight penalty. Author

**N91-32613*#** Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.).

**PROTECTION OF ELECTRICAL AND ELECTRONIC EQUIPMENT AGAINST LIGHTNING INDIRECT EFFECTS ON THE AIRBUS A340 WING c03**

Olaf Spiller *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)

Avail: NTIS HC/MF A99 CSCL 01C

The provisions applied to the Airbus A340 wing wiring against lightning indirect effects are presented. The construction and installation of the wiring's shielding systems are described, and the analysis and tests performed to determine the effectiveness of the measures taken are discussed. A first evaluation of the results of the theoretical analysis together with the provisional results of tests indicate a sufficient safety margin between required and achieved protection levels. Author

**N91-32614*#** Uppsala Univ. (Sweden). Inst. of High Voltage Research.

**FIRST AND SUBSEQUENT RETURN STROKE PROPERTIES OF CLOUD-TO-GROUND LIGHTNING**

S. Namasivayam and Stig Lundquist *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)

Avail: NTIS HC/MF A99 CSCL 04B

Lightning properties obtained by a network of magnetic direction finders and by electric field measurements for distances from 50 to 500 km are compared for three summer thunderstorms in Sweden. The data from direct field recordings indicate 31, 17, and 26 pcts. of negative subsequent return strokes with peak current (as inferred from the peak electric field) higher than the first. Electric fields from first strokes are compared with normalized amplitudes registered by the magnetic direction finding system. The efficiency of detection by the magnetic direction finding system is discussed in terms of the percentage of lightning flashes observed by electric field measurements that are not localized. Statistics of the number of strokes per flash and the interstroke time intervals are presented. Author

**N91-32615*#** Federal Armed Forces Univ., Munich (Germany, F.R.)

**CHARACTERISTICS OF RETURN STROKE ELECTRIC FIELDS PRODUCED BY LIGHTNING FLASHES AT DISTANCES OF 1 TO 15 KILOMETERS**

Ch. Hopf (Universitaet der Bundeswehr Muenchen, Neubiberg, Germany, F.R. ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 6 p (For primary document see N91-32599 24-47)

Avail: NTIS HC/MF A99 CSCL 04B

Electric field derivative signals from single and multiple lightning strokes are presented. For about 25 pct. of all acquired waveforms, produced by return strokes, stepped leaders or intracloud discharges, type and distance of the signal source are known from the observations by an all sky video camera system. The analysis of the electric field derivative waveforms in the time domain

shows a significant difference in the impulse width between return stroke signals and those of stepped leaders and intracloud discharges. In addition, the computed amplitude density spectrum of return stroke waveforms lies by a factor of 10 above that of stepped leaders and intracloud discharges in the frequency range from 50 to 500 kHz. Author

**N91-32616*#** SRI International Corp., Menlo Park, CA.
**AIRBORNE OBSERVATIONS OF ELECTRIC FIELDS AROUND GROWING AND DECAYING CUMULUS CLOUDS**
K. L. Giori and J. E. Nanevicz *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Sponsored in part by AF (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

Airborne electric field data were gathered in an atmospheric electrification study near Cape Canaveral, FL. A Learjet 36A was instrumented with eight electric field meters (mills) and five different particle probes. The local electric field enhancements at each field mill site were determined under lab conditions and verified using in-flight data. The overdetermined system of eight equations (one for each field mill) was solved using a weighted least squares algorithm to compute the magnitude and direction of the ambient electric field. The signal processing system allowed the measured data to be expressed in terms of earth coordinates, regardless of the attitude of the aircraft. Thus, it was possible to take maximum advantage of the Learjet's speed and maneuverability in studying the electric field structure in the vicinity of the clouds. Data gathered while circling just outside the boundary of a growing cumulus cloud show a nonsymmetric pattern of electric field strength. Field intensity grew rapidly over a period of less than 10 minutes. The observed direction of the ambient electric field vector can be explained by an ascending motion of the charge centers of a classic tripole model of a thunderstorm. Author

**N91-32617*#** Swedish State Power Board, Stockholm.
**LIGHTNING LOCATION SYSTEM SUPERVISING SWEDISH POWER TRANSMISSION NETWORK**
Stefan A. Melin *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

For electric utilities, the ability to prevent or minimize lightning damage on personnel and power systems is of great importance. Therefore, the Swedish State Power Board, has been using data since 1983 from a nationwide lightning location system (LLS) for accurately locating lightning ground strikes. Lightning data is distributed and presented on color graphic displays at regional power network control centers as well as at the national power system control center for optimal data use. The main objectives for use of LLS data are: supervising the power system for optimal and safe use of the transmission and generating capacity during periods of thunderstorms; warning service to maintenance and service crews at power line and substations to end operations hazardous when lightning; rapid positioning of emergency crews to locate network damage at areas of detected lightning; and post analysis of power outages and transmission faults in relation to lightning, using archived lightning data for determination of appropriate design and insulation levels of equipment. Staff have found LLS data useful and economically justified since the availability of power system has increased as well as level of personnel safety. Author

**N91-32618*#** Lightning Location and Protection, Inc., Tucson, AZ.
**RANGE ESTIMATION TECHNIQUES IN SINGLE-STATION THUNDERSTORM WARNING SENSORS BASED UPON GATED, WIDEBAND, MAGNETIC DIRECTION FINDER TECHNOLOGY**
Albert E. Pifer, William L. Hiscox, Kenneth L. Cummins, and William T. Neumann *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

Gated, wideband, magnetic direction finders (DFs) were originally designed to measure the bearing of cloud-to-ground lightning relative to the sensor. A recent addition to this device uses proprietary waveform discrimination logic to select return stroke signatures and certain range dependent features in the waveform to provide an estimate of range of flashes within 50 kms. The enhanced ranging techniques are discussed which were designed and developed for use in single station thunderstorm warning sensor. Included are the results of on-going evaluations being conducted under a variety of meteorological and geographic conditions. Author

**N91-32619*#** Dimensions, Saint Aubin (France).
**THUNDERSTORM MONITORING AND LIGHTNING WARNING, OPERATIONAL APPLICATIONS OF THE SAFIR SYSTEM**
Philippe Richard *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 6 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

During the past years a new range of studies have been opened by the application of electromagnetic localization techniques to the field of thunderstorm remote sensing. VHF localization techniques were used in particular for the analysis of lightning discharges and gave access to time resolved 3-D images of lightning discharges within thunderclouds. Detection and localization techniques developed have been applied to the design of the SAFIR system. This development's main objective was the design of an operational system capable of assessing and warning in real time for lightning hazards and potential thunderstorm hazards. The SAFIR system main detection technique is the long range interferometric localization of thunderstorm electromagnetic activity; the system performs the localization of intracloud and cloud to ground lightning discharges and the analysis of the characteristics of the activity. Author

**N91-32620*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**VHF DISCHARGES IN STORM CELLS PRODUCING MICROBURSTS**
P. Laroche, C. Malherbe, A. Bondiou, M. Weber, C. Engholm, and V. Coel (Massachusetts Inst. of Tech., Lexington.) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 13 p Previously announced in IAA as A91-45637 Sponsored in part by DRET and FAA (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

An experiment was carried out in which 3-D mapping of VHF sources was compared to a 3-D description of the reflectivity and dynamics of associated cloud cells observed by a radar network. Data from 61 microbursts were analyzed and it was found that, in 93 pct. of the cases, electrical activity precedes outflow development. The results confirm that the peak in intracloud activity precedes the maximum value of the outflow. Author

**N91-32621*#** Wesley Hospital, Brisbane (Australia).
**THE QT INTERVAL IN LIGHTNING INJURY WITH IMPLICATIONS FOR THE CESSATION OF METABOLISM HYPOTHESIS** **c52**
Christopher J. Andrews, David M. Colquhoun, and Mat Darveniza (Queensland Univ., Brisbane, Australia ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 06R

An hypothesis is presented to provide an alternative to the Cessation of Metabolism hypothesis often invoked in lightning injury. Cessation of Metabolism has been proposed to explain the observation of good recovery after a prolonged period in cardiac

arrest in some lightning injured patients. Reevaluation of EEGs from lightning injured patients show a high incidence of QT prolongation. Reexamination of the cases used to support Cessation of Metabolism also reveals little evidence to justify the hypothesis. The finding of QT prolongation coupled with the hyperadrenergic state said to exist in lightning injury, may promote a state of episodic induction of and recovery from Torsade de Pointes Ventricular Tachycardia (VT). Histological examination of the myocardium supports the new hypothesis. This the first concerted description of lightning injury as one of the general causes of QT prolongation. It appears to occur frequently after lightning injury, is a prerequisite of and predisposes to episodes of Torsade de Pointes VT. These electrocardiographic abnormalities explain Cessation of Metabolism and recognition may change management and lead to greater survival. Author

**N91-32622*#** Wesley Hospital, Brisbane (Australia).
**FURTHER IDENTIFICATION AND TREATMENT MODALITIES IN TELEPHONE MEDIATED LIGHTNING STRIKE** **c52**
Christopher J. Andrews and Mat Darveniza (Queensland Univ., Brisbane, Australia ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 8 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 06R

The results are presented of a prospective survey of people injured by lightning impulses transmitted by the public telephone system. The results are compared with those of a previous retrospective survey. Various deficiencies in the methodology of the latter survey are addressed. A division into a population with severe injury and a population with mild injury is made based on medical history and examination taken immediately after a strike. The best predictors of severe injury were found to be the presence of symptoms beyond one week after the strike, and also the initial presence of musculoskeletal injuries. Psychological upset is also seen to be a significant factor in severe injury. The only physical parameter of strike which could be used as a predictor of severe injury was the presence of concomitant power system damage. The importance of earth bonding between power and telephone system is thus supported in a protection strategy. One author draws on experience in treating patients with these injuries to propose a treatment regimen for those with ongoing symptoms. The importance of evaluating and treating psychological and physical aspects is stressed. Author

**N91-32623*#** Aerospace Corp., Los Angeles, CA.
**STEP VOLTAGE ANALYSIS FOR THE CATENOID LIGHTNING PROTECTION SYSTEM** **c52**
J. C. Chai, R. Briet, D. L. Barker, and H. E. Eley *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 06R

The main objective of the proposed overhead Catenoid Lightning Protection System (CLPS) is personnel safety. To ensure working personnel's safety in lightning situations, it is necessary that the potential difference developed across a distance equal to a person's pace (step voltage) does not exceed a separately established safe voltage in order to avoid electrocution (ventricular fibrillation) of humans. Therefore, the first stage of the analytical effort is to calculate the open circuit step voltage. An impedance model is developed for this purpose. It takes into consideration the earth's complex impedance behavior and the transient nature of the lightning phenomenon. In the low frequency limit, this impedance model is shown to reduce to results similar to those predicted by the conventional resistor model in a DC analysis. Author

**N91-32624*#** General Semiconductor Industries, Inc., Tempe, AZ.
**HARDENING COMMUNICATION PORTS FOR SURVIVAL IN ELECTRICAL OVERSTRESS ENVIRONMENTS** **c33**
O. Melville Clark *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 8 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

Greater attention is being focused on the protection of data I/O ports since both experience and lab tests have shown that components at these locations are extremely vulnerable to electrical overstress (EOS) in the form of transient voltages. Lightning and electrostatic discharge (ESD) are the major contributors to these failures; however, these losses can be prevented. Hardening against transient voltages at both the board level and system level has a proven record of improving reliability by orders of magnitude. The EOS threats, typical failure modes, and transient voltage mitigation techniques are reviewed. Case histories are also reviewed. Author

**N91-32625*#** New Mexico Inst. of Mining and Technology, Socorro. Lab. for Atmospheric Research.
**CHARGE CONTROL EXPERIMENTS ON A CH-53E HELICOPTER IN A DUSTY ENVIRONMENT** **c03**
C. B. Moore, J. J. Jones, and S. J. Hunyady *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

Charge control tests were carried out on a ground based, Marine Corps helicopter to determine if control of the electric fields acting on the engine exhaust gases could be used to reduce the electrification of the helicopter when it operated in a dusty atmosphere. The test aircraft was flown to a dusty, unpaved area and was then isolated electrically from the earth. When the helicopter engines were operated at ground idle with the rotor locked, the isolated aircraft charged positively, as had been observed previously. However, when the rotor brake was released and the turning rotor created a downdraft that raised dust clouds, the aircraft always became charged more positively, to potentials ranging form +30 to +45 kV. The dust clouds raised by the rotor downwash invariably carried negative space charges with concentrations of up to -100 nC/cu m and caused surface electric fields with strengths of up to 10 kV/m immediately down wind of the aircraft. The natural charging of the helicopter operating in these dust clouds was successfully opposed by control of the electric fields acting on the hot, electrically conductive exhaust gases. The control was achieved by placing electrostatic shield around the exhausts. Author

**N91-32626*#** Naval Air Test Center, Patuxent River, MD. Electromagnetic Pulse Section.
**RESULTS OF THE RECENT PRECIPITATION STATIC FLIGHT TEST PROGRAM ON THE NAVY P-3B ANTISUBMARINE AIRCRAFT** **c03**
Mike Whitaker *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 7 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

Severe precipitation static problems affecting the communication equipment onboard the P-3B aircraft were recently studied. The study was conducted after precipitation static created potential safety-of-flight problems on Naval Reserve aircraft. A specially designed flight test program was conducted in order to measure, record, analyze, and characterize potential precipitation static problem areas. The test program successfully characterized the precipitation static interference problems while the P-3B was flown in moderate to extreme precipitation conditions. Data up to 400 MHz were collected on the effects of engine charging, precipitation static, and extreme cross fields. These data were collected using a computer controlled acquisition system consisting of a signal generator, RF spectrum and audio analyzers, data recorders, and instrumented static dischargers. The test program is outlined and the computer controlled data acquisition system is described in detail which was used during flight and ground testing.

The correlation of test results is also discussed which were recorded during the flight test program and those measured during ground testing. Author

**N91-32627*#** Boeing Aerospace Co., Cocoa Beach, FL.
**LAUNCH PAD LIGHTNING PROTECTION EFFECTIVENESS** **c14**

James R. Stahmann *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 12 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 14B

Using the striking distance theory that lightning leaders will strike the nearest grounded point on their last jump to earth corresponding to the striking distance, the probability of striking a point on a structure in the presence of other points can be estimated. The lightning strokes are divided into deciles having an average peak current and striking distance. The striking distances are used as radii from the points to generate windows of approach through which the leader must pass to reach a designated point. The projections of the windows on a horizontal plane as they are rotated through all possible angles of approach define an area that can be multiplied by the decile stroke density to arrive at the probability of strokes with the window average striking distance. The sum of all decile probabilities gives the cumulative probability for all strokes. The techniques can be applied to NASA-Kennedy launch pad structures to estimate the lightning protection effectiveness for the crane, gaseous oxygen vent arm, and other points. Streamers from sharp points on the structure provide protection for surfaces having large radii of curvature. The effects of nearby structures can also be estimated. Author

**N91-32628*#** Naval Air Test Center, Patuxent River, MD. Electromagnetic Pulse Section.
**ACTIVATION OF THE NAVY'S INDIRECT EFFECTS LIGHTNING SIMULATION LABORATORY** **c09**

Mike Whitaker *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 14B

The Naval Air Test Center is currently the Navy's lead lab for electromagnetic effects testing. As part of this charter, it has been performing lightning effects testing on Navy aircraft in support of specification compliance since 1973. An overview is presented of lightning test and evaluation efforts at NATC, both past and present, as well as its plans for the future. The array of simulation capabilities presently operational are described, and a high level look is given to the test methodology now being used. The principal discussion centers on the results from the recent air launched ordnance test and testing of the Navy's A-6E all weather attack aircraft. Particular attention is paid to the NATC's test approach, including details about coaxial return construction, aircraft preparation, and the test waveforms and data acquisition systems that were used. Author

**N91-32629*#** Florida Univ., Gainesville. Dept. of Electrical Engineering.
**CHARACTERIZATION OF VERTICAL ELECTRIC FIELDS AND ASSOCIATED VOLTAGES INDUCED ON A OVERHEAD POWER LINE FROM CLOSE ARTIFICIALLY INITIATED LIGHTNING** **c33**

Marcos Rubinstein, Martin A. Uman, Ewen M. Thomson, and Pedro J. Medelius *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced as N91-26656 (For primary document see N91-32599 24-47)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A99 CSCL 09C

.Measurements were characterized of simultaneous vertical electric fields and voltages induced at both ends of a 448 m overhead power line by artificially initiated lightning return strokes. The lightning discharges struck ground about 20 m from one end of the line. The measured line voltages could be grouped into two categories: those in which multiple, similarly shaped, evenly spaced pulses were observed, which are called oscillatory; and those dominated by a principal pulse with subsidiary oscillations of much smaller amplitude, which are called impulsive. Voltage amplitudes range from tens of kilovolts for oscillatory voltages to hundreds of kilovolts for impulsive voltages. Author

**N91-32630*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**LIGHTNING PROTECTION FOR SHUTTLE PROPULSION ELEMENTS** **c20**

Carolyn C. Goodloe and Robert J. Giudici (Sverdrup Technology, Inc., Huntsville, AL.) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 21H

The results of lightning protection analyses and tests are weighed against the present set of waivers to the NASA lightning protection specification. The significant analyses and tests are contrasted with the release of a new and more realistic lightning protection specification, in September 1990, that resulted in an inordinate number of waivers. A variety of lightning protection analyses and tests of the Shuttle propulsion elements, the Solid Rocket Booster, the External Tank, and the Space Shuttle Main Engine, were conducted. These tests range from the sensitivity of solid propellant during shipping to penetration of cryogenic tanks during flight. The Shuttle propulsion elements have the capability to survive certain levels of lightning strikes at certain times during transportation, launch site operations, and flight. Changes are being evaluated that may improve the odds of withstanding a major lightning strike. The Solid Rocket Booster is the most likely propulsion element to survive if systems tunnel bond straps are improved. Wiring improvements were already incorporated and major protection tests were conducted. The External Tank remains vulnerable to burn-through penetration of its skin. Proposed design improvements include the use of a composite nose cone and conductive or laminated thermal protection system coatings. Author

**N91-32631*#** Centre d'Essais Aeronautique Toulouse (France).
**INFLUENCE OF CONFIGURATION EFFECTS ON MULTIPLE BURST SIMULATION TESTING** **c03**

J. L. Emanuely and M. Cantaloube *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

During the initial phase of a lightning strike attachment on an aircraft, fast current pulses (rise time approximately 100 ns, I(sub max) approximately few kA) were measured, which can create equipment upsets or disturbances. This threat, made of repetitive pulses and usually called 'multiple bursts', can be reproduced at the equipment interfaces assuming that the transfer function of the structure was determined. The normalized waveform H (10 kA - 100 ns rise time) is the reference for one of these pulses. The importance of the coaxial return path termination for the injection of the wave H is emphasized. According to the constitutive materials of the test bed, and the adaptation of the line, the natural oscillations of the structure and the internal coupling mechanisms can be modified. As a conclusion, various test configurations in relation with the nature of the test bed and the characteristics of the generator are detailed, for a more accurate ground simulation of the attachment phase. Author

**N91-32632*#** CESI, Milan (Italy). High Voltage Div.
**EVALUATION OF THE DAMAGES CAUSED BY LIGHTNING CURRENT FLOWING THROUGH BEARINGS** **c37**

O. Celi, A. Pigini, and E. Garbagnati (Ente Nazionale per l'Energia Elettrica, Milan, Italy ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning

and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 13K

A laboratory for lightning current tests was set up allowing the generation of the lightning currents foreseen by the Standards. Lightning tests are carried out on different objects, aircraft materials and components, evaluating the direct and indirect effects of lightning. Recently a research was carried out to evaluate the effects of the lightning current flow through bearings with special reference to wind power generator applications. For this purpose, lightning currents of different amplitude were applied to bearings in different test conditions and the damages caused by the lightning current flow were analyzed. The influence of the load acting on the bearing, the presence of lubricant and the bearing rotation were studied. Author

**N91-32633*#** Maxwell Labs., Inc., San Diego, CA.
**A TRANSPORTABLE 50 kA DUAL MODE LIGHTNING SIMULATOR** **c09**
K. Salisbury, S. Lloyd, and Y. G. Chen *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 7 p (For primary document see N91-32599 24-47)
(Contract B239503)
Avail: NTIS HC/MF A99 CSCL 14B

A transportable lightning simulator was designed, built and tested, which is capable of delivering more than 50 kA to an 8 micro-H test object. The simulator was designed to be a versatile device in the lightning laboratory while meeting the requirements of MIL-STD-1757A for component E current waveforms. The system is capable of operating in either a ringing mode with a Q greater than 5 and a nominal frequency of 160 kHz, or a unipolar mode with no hardware configuration changes. The ringing mode is obtained by the LCR series circuit formed by the pulse generator and test object. The unipolar mode is obtained by closing an electrically triggered crowbar switch at peak current. The simulator exceeds the peak current requirement and rate of rise requirements for MIL-STD-1757A in both the ringing and unipolar modes. The pulse half width in the unipolar mode is in excess of 50 microsec and the action is in excess of 10(exp 5) A(exp 2)s. The design, component values, and test results are presented. Author

**N91-32634*#** Nis Univ. (Yugoslavia).
**MATHEMATICAL MODELS FOR DETERMINING THE PROTECTED SPACES OF THE VERTICAL LIGHTNING ROD**
I. Mladenovic and A. Vorgucic *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 7 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

Two mathematical models are presented for determining the protected spaces of the vertical lightning-rod. In the first model there was applied the circular approximation. Through the introduction of the modified striking distance in the second improved approximation there was obtained a new model for the protected space of the lightning-rod. The models are of general type, foreseen for the three-dimensional space and they are simply applied on solving the practical problems. Author

**N91-32635*#** Federal Aviation Administration, Atlanta, GA.
**DESIGNS FOR SURGE IMMUNITY IN CRITICAL ELECTRONIC FACILITIES** **c33**
Edward F. Roberts, Jr. *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 7 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

In recent years, Federal Aviation Administration (FAA) embarked on a program replacing older tube type electronic equipment with newer solid state equipment. This replacement program dramatically increased the susceptibility of the FAA's facilities to lightning related damages. The proposal is presented of techniques which may be employed to lessen the susceptibility of new FAA electronic facility designs to failures resulting from lightning related surges and transients as well as direct strikes. The general concept espoused is one of a consistent system approach employing both perimeter and internal protection. It compares the technique presently employed to reduce electronic noise with other techniques which reduce noise while lowering susceptibility to lightning related damage. It is anticipated that these techniques will be employed in the design of an Air Traffic Control Tower in a high isokeraunic area. This facility would be subjected to rigorous monitoring over a multi-year period to provide quantitative data hopefully supporting the advantage of this design. Author

**N91-32636*#** Sandia National Labs., Albuquerque, NM.
**THE SANDIA TRANSPORTABLE TRIGGERED LIGHTNING INSTRUMENTATION FACILITY** **c09**
George H. Schnetzer and Richard J. Fisher *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p Previously announced as N91-18564 Sponsored in part by Army (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 14B

Development of the Sandia Transportable Triggered Lightning Instrumentation Facility (SATTLIF) was motivated by a requirement for the in situ testing of a munitions storage bunker. Transfer functions relating the incident flash currents to voltages, currents, and electromagnetic field values throughout the structure will be obtained for use in refining and validating a lightning response computer model of this type of structure. A preliminary shakedown trial of the facility under actual operational conditions was performed during summer of 1990 at the Kennedy Space Center's (KSC) rocket-triggered lightning test site. A description is given of the SATTLIF, which is readily transportable on a single flatbed truck of by aircraft, and its instrumentation for measuring incident lightning channel currents and the responses of the systems under test. Measurements of return-stroke current peaks obtained with the SATTLIF are presented. Agreement with data acquired on the same flashes with existing KSC instrumentation is, on average, to within approximately 7 percent. Continuing currents were measured with a resolution of approximately 2.5 A. This field trial demonstrated the practicality of using a transportable triggered lightning facility for specialized test applications. Author

**N91-32637*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**FD-TD CALCULATION WITH COMPOSITE MATERIALS. APPLICATION TO C160 AIRCRAFT MEASUREMENTS** **c03**
J. C. Alliot, J. Grando, F. Issac, and X. Ferrieres (SLX Informatique, Courbevoie, France ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

In a frequency domain in which a material thickness is smaller than the skin depth, a formalism based on the sheet impedance concept was developed and introduced in the FD-TD (finite difference-time domain) code ALICE. The predictive capabilities of the 3D code was evaluated by comparison to analytical and experimental data. The following subject areas are covered: low frequency electromagnetic penetration of loaded apertures; FD-TD modeling; and in-flight experiment modeling. Author

**N91-32638*#** United Kingdom Atomic Energy Authority, Abingdon (England).
**THE ELECTROMAGNETIC ENVIRONMENT IN CFC STRUCTURES** **c33**
C. J. Hardwick and S. J. Haigh *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Sponsored in part by the Culham Lightning Club; British Aerospace, Rolls Royce, Westlands, CASA, SAAB, Shorts, CAA and DTI (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

Extensive measurements of induced voltages and currents were

made using a CFC (carbon fiber composites) horizontal stabilizer from the A320 as a test bed. The work was done to investigate the efficacy of various protection schemes to reduce the magnitudes of the induced voltages and validate a computer program INDCAL. Results indicate that a good understanding of the various induced voltage mechanisms including the long wave effect due to current redistribution was obtained. Author

**N91-32639*#** United Kingdom Atomic Energy Authority, Abingdon (England).
**A NEW APPROACH TO EQUIPMENT TESTING c33**
C. J. Hardwick, V. P. Dunkley, B. J. C. Burrows, and I. Darney *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Sponsored in part by Culham Lightning Club, British Aerospace, Rolls Royce, Westlands, CASA, SAAB, Shorts, CAA and DTI (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

Considerable controversy has arisen during the recent discussions over a new version of the RTCA DO160C/ED 14C Section 22 document at the European Committee for Aviation Electronics. Section 22 is concerned with lightning waveform tests to equipment. Investigations of some of these controversies with circuit analysis and measurements indicate the impedance characteristics required of the transient generators and the possibility of testing to a voltage limit even for current waveforms. Author

**N91-32640*#** Sandia National Labs., Albuquerque, NM.
**DAMAGE TO METALLIC SAMPLES PRODUCED BY MEASURED LIGHTNING CURRENTS c26**
Richard J. Fisher and George H. Schnetzer *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced as N91-18565 Sponsored in part by Army (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 11F

A total of 10 sample disks of 2024-T3 aluminum and 4130 ferrous steel were exposed to rocket-triggered lightning currents at the Kennedy Space Center test site. The experimental configuration was arranged so that the samples were not exposed to the preliminary streamer, wire-burn, or following currents that are associated with an upward-initiated rocket-triggered flash but which are atypical of naturally initiated lightning. Return-stroke currents and continuing currents actually attaching to the sample were measured, augmented by close-up video recordings of approximately 3 feet of the channel above the sample and by 16-mm movies with 5-ms resolution. From these data it was possible to correlate individual damage spots with streamer, return-stroke, and continuing currents that produced them. Substantial penetration of 80-mil aluminum was produced by a continuing current of submedian amplitude and duration, and full penetration of a 35-mil steel sample occurred under an eightieth percentile continuing current. The primary purpose of the data acquired in these experiments is for use in improving and quantifying the fidelity of laboratory simulations of lightning burnthrough. Author

**N91-32641*#** Atlantic Research Corp., Arlington, VA. Professional Services Group.
**AN ASSESSMENT OF TAILORING OF LIGHTNING PROTECTION DESIGN REQUIREMENTS FOR A COMPOSITE WING STRUCTURE ON A METALLIC AIRCRAFT c03**
T. L. Harwood *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 12 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

The Navy A-6E aircraft is presently being modified with a new wing which uses graphite/epoxy structures and substructures around a titanium load-bearing structure. The ability of composites to conduct electricity is less than that of aluminum. This is cause for concern when the wing may be required to conduct large lightning currents. The manufacturer attempted to solve lightning protection issues by performing a risk assessment based on a statistical approach which allows relaxation of the wing lightning protection design levels over certain locations of the composite wing. A sensitivity study is presented designed to define the total risk of relaxation of the design levels. Author

**N91-32642*#** United Kingdom Atomic Energy Authority, Abingdon (England).
**LIGHTNING PROTECTION DESIGN AND TESTING OF AN ALL COMPOSITE WET WING FOR THE EGRETT c03**
B. J. C. Burrows, S. J. Haigh, C. Chessum, and V. P. Dunkley *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p Sponsored in part by Grob Aircraft Co., Mindelheim, Fed. Republic of Germany (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

The Egrett aircraft has an all composite wing comprising CFC(carbon fiber composite)/Nomex sandwich skins, full length CFC main spar caps, and GFRP (glass fiber reinforced plastics) main and auxiliary spar webs. It also has short inboard CFC auxiliary spar caps. It has fine aluminum wires woven into the surface for protection. It has an integral fuel tank using the CFC/Nomex skins as the upper and lower tank walls, and lies between the forward auxiliary spar and the forward of the two main spar webs. The fuel tank is not bagged, i.e., it is in effect a wet wing tank. It has conventional capacitive type fuel gauging. The aircraft was cleared to IFR standards and so required full lightning protection and demonstration that it would survive the lightning environment. The lightning protection was designed for the wing (and also for the remainder of the aircraft). An inner wing test samples (which included a part of the fuel tank) were tested as part of the proving program. The protection design and the testing process are described. The intrinsic structural features are indicated that improve lightning protection design and which therefore minimize the weight and cost of any added lightning protection components. Author

**N91-32643*#** Raychem Ltd., Swindon (England).
**LIGHTNING PROTECTION OF FULL AUTHORITY DIGITAL ELECTRONIC SYSTEMS c33**
David Crofts *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09C

Modern electronic systems are vulnerable to transient and they now provide safety critical functions such as full authority digital electronic control (FADEC) units for fly by wire aircraft. Of the traditional suppression technologies available diodes have gained the wider acceptance, however, they lack the current handling capacity to meet existing threat levels. The development of high speed fold back devices where, at a specified voltage, the off state resistance switches to a very low on state one has provided the equivalent to a semiconductor spark gap. The size of the technology enables it to be integrated into connectors of interconnection cables. To illustrate the performance the technology was developed to meet the Lightning Protection requirements for FADEC units within aeroengines. Work was also carried out to study switching behavior with the waveform 5, the 500 us, 10 kA pulse applied to cable assemblies. This test enabled all the switches in a connector to be fired simultaneously. Author

**N91-32644*#** Federal Armed Forces Univ., Munich (Germany, F.R.)
**SIMULATION AND MEASUREMENT OF MELTING EFFECTS ON METAL SHEETS CAUSED BY DIRECT LIGHTNING STRIKES c26**
Alexander Kern (Universitaet der Bundeswehr Muenchen, Neubiberg, Germany, F.R. ) *In* NASA. Kennedy Space Center,

The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 11F

Direct lightning strikes melt metal parts of various systems, like fuel and propellant tanks of rockets and airplanes, at the point of strike. Responsible for this melting are the impulse current and, if occurring, the long duration current, both carrying a remarkable charge Q. For studying these meltings the simulation in the laboratory has to be based on the parameters of natural lightnings. International standards exist defining certain threat levels of natural lightnings and giving possible generator circuits for the simulation. The melting caused by both types of lightning currents show different appearance. Their characteristics, their differences in melting and heating of metal sheets are investigated. Nevertheless the simulation of lightning in the laboratory is imperfect. While natural lightning is a discharge without a counter electrode, the simulation always demands a close counter electrode. The influence of this counter electrode is studied.
Author

**N91-32645*#** Air Force Geophysics Lab., Hanscom AFB, MA. Atmospheric Sciences Div.
**A SURVEY OF LASER LIGHTNING ROD TECHNIQUES c36**
Arnold A. Barnes, Jr. and Robert O. Berthel *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 6 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 20E

The work done to create a laser lightning rod (LLR) is discussed. Some ongoing research which has the potential for achieving an operational laser lightning rod for use in the protection of missile launch sites, launch vehicles, and other property is discussed. Because of the ease with which a laser beam can be steered into any cloud overhead, an LLR could be used to ascertain if there exists enough charge in the clouds to discharge to the ground as triggered lightning. This leads to the possibility of using LLRs to test clouds prior to launching missiles through the clouds or prior to flying aircraft through the clouds. LLRs could also be used to probe and discharge clouds before or during any hazardous ground operations. Thus, an operational LLR may be able to both detect such sub-critical electrical fields and effectively neutralize them.
Author

**N91-32646*#** Air Force Geophysics Lab., Hanscom AFB, MA. Atmospheric Sciences Div.
**PREDICTING CLOUD-TO-GROUND LIGHTNING WITH NEURAL NETWORKS c63**
Arnold A. Barnes, Jr., Donald Frankel, and James Stark Draper (KTAADN, Inc., Newton, MA.) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced in IAA as A90-19873, and as N91-18555 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09B

A neural network is being trained to predict lightning at Cape Canaveral for periods up to two hours in advance. Inputs consist of ground based field mill data, meteorological tower data, lightning location data, and radiosonde data. High values of the field mill data and rapid changes in the field mill data, offset in time, provide the forecasts or desired output values used to train the neural network through backpropagation. Examples of input data are shown and an example of data compression using a hidden layer in the neural network is discussed.
Author

**N91-32647*#** Toyota Coll. of Technology (Japan).
**THE ELECTRIC FIELD CHANGE CAUSED BY A GROUND FLASH WITH MULTIPLE CHANNELS**
Minoru Nakano, Nobuyuki Takagi, Izumi Arima, Zen-Ichiro Kawasaki, and Tosio Takeuti (Aichi Coll. of Technology, Gamagori, Japan ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 8 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

The electric field and the magnetic flux changes caused by a ground flash with multiple channels are measured near the electric power transmission lines during winter thunderstorms. Triggered lightning strokes and the following associated strokes to the transmission line towers produce characteristic waveforms of the field changes. A few examples of the waveforms and a brief discussion are given.
Author

**N91-32648*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**FD-TD NUMERICAL SIMULATION OF AN ENTIRE LIGHTNING STRIKE ON THE C160 AIRCRAFT c03**
J. C. Alliot, J. Grando, J. D. Muller, and X. Ferrieres (SLX Informatique, Courbevoie, France ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p Previously announced in IAA as A91-45619 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

Experimental transient electromagnetic field measurements were performed on a Transall C160 aircraft during in-flight lightning strikes. The data allow a test of the predictive capabilities of a three dimensional time domain finite difference code (ALICE) developed at ONERA in order to investigate lightning-aircraft interactions. Using a transfer function technique in the 3D code, it is shown that a bi-leader attached to an aircraft can be simulated by a linear model, and so the electromagnetic fields can be calculated anywhere on the vehicle. Comparison of experimental and numerical results were made for several lightning strikes. Skin current density and electromagnetic field distributions are discussed in detail.
Author

**N91-32649*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Environment Electromagnetique.
**OBSERVATIONS OF BI-DIRECTIONAL LEADER DEVELOPMENT IN A TRIGGERED LIGHTNING FLASH**
P. Laroche, V. Idone, A. Eybert-Berard, and L. Barret (Commissariat a l'Energie Atomique, Grenoble, France ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced in IAA as A91-45636 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

Observations of a modified form of rocket triggered lightning are described. A flash triggered during the summer of 1989 is studied as part of an effort to model bidirectional discharge. It is suggested that the altitude triggering technique provides a realistic means of studying the attachment process.
Author

**N91-32650*#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**APPLICATION OF SURFACE ELECTRICAL DISCHARGES TO THE STUDY OF LIGHTNING STRIKES ON AIRCRAFT c03**
J. L. Boulay and S. Larigaldie *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced in IAA as A91-45612 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 01C

Considered here is the characterization of surface discharges which provide a facility complementary to that of artificially triggered lightning. General characteristics of a simplified surface discharge, including current waveforms and the constitution of a surface discharge are outlined, and the application of this approach to the study of aircraft lightning strikes is considered. Representations of leader-streamer and return-stroke phases are discussed, and the application to the two-dimensional discharge phase is covered. It is noted that the fact that the initiation times of surface discharges could be controlled, and the path followed by the discharge

channels could be predetermined, indicates that it is possible to produce a highly dedicated high performance instrumentation system. Author

**N91-32651*#** SRI International Corp., Menlo Park, CA.
**SCALE-MODEL CHARGE-TRANSFER TECHNIQUE FOR MEASURING ENHANCEMENT FACTORS** **c03**
J. Kositsky and J. E. Nanevicz *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
(Contract F04701-90-C-0023)
Avail: NTIS HC/MF A99 CSCL 01C

Determination of aircraft electric field enhancement factors is crucial when using airborne field mill (ABFM) systems to accurately measure electric fields aloft. SRI used the scale model charge transfer technique to determine enhancement factors of several canonical shapes and a scale model Learjet 36A. The measured values for the canonical shapes agreed with known analytic solutions within about 6 percent. The laboratory determined enhancement factors for the aircraft were compared with those derived from in-flight data gathered by a Learjet 36A outfitted with eight field mills. The values agreed to within experimental error (approx. 15 percent). Author

**N91-32652*#** Osaka Univ. (Japan).
**THE ELECTRIC FIELD CHANGES AND UHF RADIATIONS CAUSED BY THE TRIGGERED LIGHTNING IN JAPAN**
Zen-Ichiro Kawasaki, Tadashi Kanao, Kenji Matsuura, Minoru Nakano, Kenji Horii, and Koichi Nakamura (Nagoya Inst. of Tech., Japan ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 18 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

In the rocket triggered lightning experiment of fiscal 1989, researchers observed electromagnetic field changes and UHF electromagnetic radiation accompanying rocket triggered lightning. It was found that no rapid changes corresponding to the return stroke of natural lightning were observed in the electric field changes accompanying rocket triggered lightning. However, continuous currents were present. In the case of rocket triggered lightning to the tower, electromagnetic field changes corresponding to the initiation of triggered lightning showed a bipolar pulse of a relatively large amplitude. In contrast, the rocket triggered lightning to the ground did not have such a bipolar pulse. The UHF radiation accompanying the rocket triggered lightning preceded the waveform portions corresponding to the first changes in electromagnetic fields. The number of isolated pulses in the UHF radiation showed a correlation with the time duration from rocket launching up to triggered lightning. The time interval between consecutive isolated pulses tended to get shorter with the passage of time, just like the stepped leaders of natural lightning. Author

**N91-32653*#** Laboratoire d'Aerologie, Toulouse (France).
**THE DETECTION OF THE ELECTRIC FIELD VERTICAL DISTRIBUTION UNDERNEATH THUNDERCLOUD: PRINCIPLE AND APPLICATIONS**
Serge Soula and Serge Chauzy *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 12 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

During the Florida 89 experiment at Kennedy Space Center, a new system was used in order to obtain the vertical distribution of the electric field underneath thunderstorms. It consists of a standard shutter field mill at ground level and five other field sensors suspended from a cable fastened to a tethered balloon located at an altitude of about 1000 meters. It also includes a reception station for telemetered information transmitted by sensors, a processing system in order to store data, and real time display on a screen to show the simultaneous field variations at each level along with the instantaneous electric field profile. The first results obtained show the great importance of the electric field vertical distribution. The field detected at a height of 600m reaches 65 kV/m while that at the surface does not exceed 5 kV/m. The field intensity in altitude is a better criterion for determining the right moment to launch a rocket devoted to flash triggering. Using Gauss's law, the simultaneous field variations at several levels are used in order to evaluate charge densities. Average values close to 1nC.m(-3) are calculated in layers up to 600 m. The calculation of different average charge densities leads to the characterization of the layer between cloud and ground just before the leader propagation in the case of cloud to ground flash. Author

**N91-32654*#** Nagoya Inst. of Tech. (Japan).
**DISCUSSIONS ON A LONG GAP DISCHARGE TO AN EHV TRANSMISSION TOWER BY A ROCKET TRIGGERED LIGHTNING EXPERIMENT**
Koichi Nakamura, Atsushi Wada, and Kenji Horii (Toyota Coll. of Technology, Japan ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 04B

The triggered lightning experiments using a rocket have been carried out on a winter mountain in Japan since 1986. For the four years from 1986 to 1989, 39 rockets were launched and 19 of them triggered lightning strikes. The emphasis here is on the methodology for triggering lightning to the transmission system. Completed experiments are discussed. The failure of lightning protection and the striking distance are noted. Author

**N91-32655*#** Uppsala Univ. (Sweden). Inst. of High Voltage Research.
**CORRELATION BETWEEN SOME CURRENT PARAMETERS AND OPTICAL RADIATION GENERATED BY 280 mm LONG LABORATORY SPARKS**
Dan Windmar, Vernon Cooray, and Viktor Scuka *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 8 p (For primary document see N91-32599 24-47)
(Contract G-GU-2789-303; E-EG-1448-301)
Avail: NTIS HC/MF A99 CSCL 04B

Discussed here is the optical radiation generated by 280 mm long laboratory discharges and its relationship to the current flowing in the discharge channel. In an experiment, the optical radiation generated by the discharges was measured at wavelengths 777nm (bandwidth 10 nm) due to O I(1), and 500 nm (bandwidth 5 nm) due to N II(19), and the broadband optical radiation between the wavelengths 400 to 1100 nm. The shape of the current waveform, which had a rise time of 0.1 microsecond and a decay time of 5 microsecond, remained the same with increasing peak value. The experiment was conducted with peak current amplitudes in the range of 1-4 kA. In order to test the effect of current rise time on the optical radiation, researchers also conducted studies with a current waveform having a 5 microsecond rise time. It was observed that the peak amplitude of the optical radiation pulse at the wavelengths mentioned above is proportional to the peak amplitude of the current flowing through the discharge channel. The rise time of the optical radiation pulse at a given wavelength does not depend significantly on the peak amplitude of the current waveform. The rise time of the optical radiation pulse decreases with decreasing wavelength. A slight increase in the decay time of the optical pulse, at a given wavelength, is observed with increasing peak amplitude of the current waveform.The results show that the rise time of the optical radiation pulse increases with the increasing rise time of the current waveform. The relationship between peak current, peak optical power, and peak electrical power is studied. Also, the relationship between peak current, optical energy (400-1100 and 777 nm), and electrical energy is discussed. Author

**N91-32656*#** Electro Magnetic Applications, Inc., Lakewood, CO.
**THE EFFECTS OF THE EXHAUST PLUME ON THE LIGHTNING TRIGGERING CONDITIONS FOR LAUNCH VEHICLES c20**
Frederick J. Eriksen, Terence H. Rudolph, and Rodney A. Perala *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 21H

Apollo 12 and Atlas Centaur 67 are two launch vehicles that have experienced triggered lightning strikes. Serious consequences resulted from the events; in the case of Atlas Centaur 67, the vehicle and the payload were lost. These events indicate that it is necessary to develop launch rules which would prevent such occurrences. In order to develop valid lightning related rules, it is necessary to understand the effects of the plume. Some have assumed that the plume can be treated as a perfect conductor, and have computed electric field enhancement factors on that basis. The authors have looked at the plume, and believe that these models are not correct, because they ignore the fluid motion of the conducting plates. The authors developed a model which includes this flow character. In this model, the external field is excluded from the plume as it would be for any good conductor, but, in addition, the charge must distribute so that the charge density is zero at some location in the exhaust. When this condition is included in the calculation of triggering enhancement factors, they can be two to three times larger than calculated by other methods which include a conductive plume but don't include the correct boundary conditions. Here, the authors review the relevant features of rocket exhausts for the triggered lightning problem, present an approach for including flowing conductive gases, and present preliminary calculations to demonstrate the effect that the plume has on enhancement factors. Author

**N91-32657*#** Uppsala Univ. (Sweden). Inst. of High Voltage Research.
**POWER AND ENERGY DISSIPATION IN SUBSEQUENT RETURN STROKES AS PREDICTED BY A NEW RETURN STROKE MODEL**
Vernon Cooray *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p (For primary document see N91-32599 24-47)
(Grant E-EG-1448-303)
Avail: NTIS HC/MF A99 CSCL 04B

Recently, Cooray introduced a new return stroke model which is capable of predicting the temporal behavior of the return stroke current and the return stroke velocity as a function of the height along the return stroke channel. The authors employed this model to calculate the power and energy dissipation in subsequent return strokes. The results of these calculations are presented here. It was concluded that a large fraction of the total energy available for the dart leader-subsequent stroke process is dissipated in the dart leader stage. The peak power per unit length dissipated in a subsequent stroke channel element decreases with increasing height of that channel element from ground level. For a given channel element, the peak power dissipation increases with increasing current in that channel element. The peak electrical power dissipation in a typical subsequent return stroke is about 1.5 times 10(exp 11) W. The energy dissipation in a subsequent stroke increases with increasing current in the return stroke channel, and for a typical subsequent stroke, the energy dissipation per unit length is about 5.0 times 10(exp 3) J/m. Author

**N91-32658*#** Uppsala Univ. (Sweden). Inst. of High Voltage Research.
**HORIZONTAL FIELDS GENERATED BY RETURN STROKES**
Vernon Cooray *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p (For primary document see N91-32599 24-47)
(Grant E-EG-1448-303)
Avail: NTIS HC/MF A99 CSCL 04B

Horizontal fields generated by return strokes play an important role in the interaction of lightning generated electric fields with power lines. In many of the recent investigations on the interaction of lightning electromagnetic fields with power lines, the horizontal field was calculated by employing the expression for the tilt of the electric field of a plane wave propagating over finitely conducting earth. The method is suitable for calculating horizontal fields generated by return strokes at distances as close as 200m. At these close ranges, the use of the wavetilt expression can cause large errors. Author

**N91-32659#** World Meteorological Organization, Geneva (Switzerland).
**INFORMATION OF METEOROLOGICAL EXTREMES FOR THE DESIGN AND OPERATION OF ENERGY SYSTEMS World Climate Applications Programme**
G. A. McKay Sep. 1990 48 p
(WCAP-13; WMO/TD-385) Avail: NTIS HC/MF A03; print copy available at WMO, Geneva, Switzerland

Ways are reviewed in which meteorological services can help mitigate costly and adverse effects of daily/monthly and seasonal extreme events on energy systems, and thereby contribute significantly to national economies. The considered extremes are in intensity, duration, or combination of meteorological elements. The main focus is on energy systems, identifying those features that appear to be most vulnerable and at the same time critical to system efficiency and effectiveness. Author

**N91-32660*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**NASA/MSFC FY91 GLOBAL SCALE ATMOSPHERIC PROCESSES RESEARCH PROGRAM REVIEW**
Fred W. Leslie, ed. Washington Sep. 1991 94 p Conference held in Huntsville, AL, 28-31 May 1991
(NASA-CP-3126; M-669; NAS 1.55:3126) Avail: NTIS HC/MF A05 CSCL 04B

The reports presented at the annual Marshall Research Review of Earth Science and Applications are compiled. The following subject areas are covered: understanding of atmospheric processes in a variety of spatial and temporal scales; measurements of geophysical parameters; measurements on a global scale from space; the Mission to Planet Earth Program (comprised of and Earth Observation System and the scientific strategy to analyze these data); and satellite data analysis and fundamental studies of atmospheric dynamics. For individual titles, see N91-32661 through N91-32692.

**N91-32661*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**GLOBAL WATER CYCLE**
Franklin R. Robertson, John R. Christy, Steven J. Goodman, Tim L. Miller, Dan Fitzjarrald, Bill Lapenta, and Shouping Wang (Universities Space Research Association, Huntsville, AL.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 1-3 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

The primary objective is to determine the scope and interactions of the global water cycle with all components of the Earth system and to understand how it stimulates and regulates changes on both global and regional scales. The following subject areas are covered: (1) water vapor variability; (2) multi-phase water analysis; (3) diabatic heating; (4) MSU (Microwave Sounding Unit) temperature analysis; (5) Optimal precipitation and streamflow analysis; (6) CCM (Community Climate Model) hydrological cycle; (7) CCM1 climate sensitivity to lower boundary forcing; and (8) mesoscale modeling of atmosphere/surface interaction. Author

**N91-32662*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**BASIC STUDIES OF BAROCLINIC FLOWS**

Tim L. Miller, S.-H. Chou, Fred W. Leslie, H.-I. Lu, and K. A. Butler (New Technology, Inc., Huntsville, AL.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 5-6 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

Computations were completed of transition curves in the conventional annulus, including hysteresis effect. The model GEOSIM was used to compute the transition between axisymmetric flow and baroclinic wave flow in the conventional annulus experiments. Thorough testing and documentation of the GEOSIM code were also completed. The Spacelab 3 results from the Geophysical Fluid Flow Cell (GFFC) were reviewed and numerical modeling was performed of many of the cases with horizontal temperature gradients as well as heating from below, with different rates of rotation. A numerical study of the lower transition to axisymmetric flow in the baroclinic annulus was performed using GEOSIM. Author

**N91-32663*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**CLIMATE DYNAMICS EXPERIMENTS USING A GCM SIMULATIONS**
Dan Fitzjarrald, Franklin R. Robertson, John R. Christy, H.-I. Lu, B. Sohn, and J. Srikishen (Universities Space Research Association, Huntsville, AL.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 7 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

The study of surface-atmosphere interactions has begun with studies of the effect of altering the ocean and land boundaries. A ten year simulation of global climate using observed sea surface temperature anomalies has begun using the NCAR Community Climate Model (CCM1). The results for low resolution (R15) were computed for the first 8 years of the simulation and compared with the observed surface temperatures and the MSU (Microwave Sounding Unit) observations of tropospheric temperature. A simulation at higher resolution (T42) was done to ascertain the effect of interactive soil hydrology on the system response to an El Nino sea surface temperature perturbation. Initial analysis of this simulations was completed. Author

**N91-32664*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**MAMS: HIGH RESOLUTION ATMOSPHERIC MOISTURE/SURFACE PROPERTIES**
Gary J. Jedlovec, Anthony R. Guillory, Ron Suggs, Robert J. Atkinson, and Grant S. Carlson (Universities Space Research Association, Huntsville, AL.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 9-11 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

Multispectral Atmospheric Mapping Sensor (MAMS) data collected from a number of U2/ER2 aircraft flights were used to investigate atmospheric and surface (land) components of the hydrologic cycle. Algorithms were developed to retrieve surface and atmospheric geophysical parameters which describe the variability of atmospheric moisture, its role in cloud and storm development, and the influence of surface moisture and heat sources on convective activity. Techniques derived with MAMS data are being applied to existing satellite measurements to show their applicability to regional and large process studies and their impact on operational forecasting. Author

**N91-32665*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**AMPR/SSMI DATA COMPARISONS**
Roy W. Spencer, Robbie Hood, and Frank LaFontaine (Universities Space Research Association, Huntsville, AL.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 13 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

The AMPR (Advanced Microwave Precipitation Radiometer) was flown for the first time with successful data collection over precipitation targets in Florida and off the Oregon coast. The AMPR met its expected performance levels with very low noise and relatively troublefree operation. Numerous rain cloud systems over land and ocean were overflown and the measurements at 10.7, 19.35, 37.1, and 85.5 GHz reveal a wide variety of microphysical conditions which exist within rain cloud systems. Although predicted by radiative transfer model calculations from cloud model simulations, this diversity was not observed before due to the poor spatial resolution of spaceborne microwave radiometers. Saturation of the 19.35 GHz rain emission signal was frequently observed in the oceanic rain systems, supporting the desirability of a 10 GHz channel on the TRMM (Tropical Rain Measuring Mission) microwave radiometer for sensitivity to the higher rain rates. Author

**N91-32666*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**ATMOSPHERIC AEROSOL AND DOPPLER LIDAR STUDIES**
Jeff Rothermel, D. A. Bowdle, V. Srivastava, M. Jarzembski, D. Cutten, and E. W. McCaul, Jr. (Universities Space Research Association, Huntsville, AL.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 15-17 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

Experimental and theoretical studies were performed of atmospheric aerosol backscatter and atmospheric dynamics with Doppler lidar as a primary tool. Activities include field and laboratory measurement and analysis efforts. The primary focus of activities related to understanding aerosol backscatter is the GLObal Backscatter Experiment (GLOBE) program. GLOBE is a multi-element effort designed toward developing a global aerosol model to describe tropospheric clean background backscatter conditions that Laser Atmospheric Wind Sounder (LAWS) is likely to encounter. Two survey missions were designed and flown in the NASA DC-8 in November 1989 and May to June 1990 over the remote Pacific Ocean, a region where backscatter values are low and where LAWS wind measurements could make a major contribution. The instrument complement consisted of pulsed and continuous-wave (CW) CO2 gas and solid state lidars measuring aerosol backscatter, optical particle counters measuring aerosol concentration, size distribution, and chemical composition, a filter/impactor system collecting aerosol samples for subsequent analysis, and integrating nephelometers measuring visible scattering coefficients. The GLOBE instrument package and survey missions were carefully planned to achieve complementary measurements under clean background backscatter conditions. Author

**N91-32667*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**GLOBAL LIGHTNING STUDIES**
Steven J. Goodman, Pat Wright, Hugh Christian, Richard Blakeslee, Dennis Buechler, and Greg Scharfen *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 19-20 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

The global lightning signatures were analyzed from the DMSP Optical Linescan System (OLS) imagery archived at the National Snow and Ice Data Center. Transition to analysis of the digital archive becomes available and compare annual, interannual, and seasonal variations with other global data sets. An initial survey of the quality of the existing film archive was completed and lightning signatures were digitized for the summer months of 1986 to 1987. The relationship is studied between: (1) global and regional lightning activity and rainfall, and (2) storm electrical development and environment. Remote sensing data sets obtained from field programs are used in conjunction with satellite/radar/lightning data to develop and improve precipitation estimation algorithms, and to provide a better understanding of the co-evolving electrical, microphysical, and dynamical structure of storms. Author

**N91-32668*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**WETNET OPERATIONS**
H. Michael Goodman, Matt Smith, Vada LaFontaine, Frank LaFontaine, and Don Moss (Alabama Univ., Huntsville.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 21-24 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

WetNet is an interdisciplinary Earth science data analysis and research project with an emphasis on the study of the global hydrological cycle. The project goals are to facilitate scientific discussion, collaboration, and interaction among a selected group of investigators by providing data access and data analysis software on a personal computer. The WetNet system fulfills some of the functionality of a prototype Product Generation System (PGS), Data Archive and Distribution System (DADS), and Information Management System for the Distributed Active Archive Center. The PGS functionality is satisfied in WetNet by processing the Special Sensor Microwave/Imager (SSM/I) data into a standard format (McIDAS) data sets and generating geophysical parameter Level II browse data sets. The DADS functionality is fulfilled when the data sets are archived on magneto optical cartridges and distributed to the WetNet investigators. The WetNet data sets on the magneto optical cartridges contain the complete WetNet processing, catalogue, and menu software in addition to SSM/I orbit data for the respective two week time period. Author

**N91-32669*#** Alabama Univ., Huntsville.
**ADVANCED VISUALIZATION TECHNIQUES c61**
Mike Botts *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 25-27 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 09B

The scientific computing needs of the Earth Science and Application Division (ESAD) were evaluated, and it was determined whether the existing visualization environment provides the proper tools for meeting those needs. Some of the deficiencies were corrected using off-the-shelf software. The following subject areas are covered: (1) evaluation of visualization environment at ESAD; (2) definition of science needs; (3) evaluation of available sortware/hardware; and (4) definition of software development environment. Author

**N91-32670*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**INTERACTIVE ACCESS AND MANAGEMENT FOR FOUR-DIMENSIONAL ENVIRONMENTAL DATA SETS USING McIDAS c82**
William L. Hibbard and Gregory J. Tripoli *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 29-31 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 05B

Significant accomplishments in the following areas are presented: (1) enhancements to the visualization of 5-D data sets (VIS-5D); (2) development of the visualization of global images (VIS-GI) application; (3) design of the Visualization for Algorithm Development (VIS-AD) System; and (4) numerical modeling applications. The focus of current research and future research plans is presented and the following topics are addressed: (1) further enhancements to VIS-5D; (2) generalization and enhancement of the VIS-GI application; (3) the implementation of the VIS-AD System; and (4) plans for modeling applications.
Author

**N91-32671*#** National Center for Atmospheric Research, Boulder, CO.
**RESEARCH ON DIABATIC INITIALIZATION c82**
Akira Kasahara *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 33-35 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 05B

The objective was to contribute to the improvement of the analyses of irrotational wind and moisture fields in the trophics through advancement in the technique of initialization by incorporating diabatic effects. Significant accomplishments made during the period May 1990 to April 1991 in the following areas are presented: (1) estimation of the uncertainty of daily synoptic analyses in the tropics; (2) normal modes of Laplace's tidal equations for zonal wavenumber zero; and (3) tropical initialization to ameliorate the spin-up problem of precipitation forecasts. The focus of current research and plans for next year are also presented. Author

**N91-32672*#** Florida State Univ., Tallahassee. Geophysical Fluid Dynamics Inst.
**POTENTIAL VORTICITY INDEX c45**
Albert Barcilon and Hengyi Weng *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 37-39 (For primary document see N91-32660 24-47)
(Grant NAG8-760)
Avail: NTIS HC/MF A05 CSCL 13B

Based on the European Center For Medium Range Weather Forecasting (ECMWF) First Global Atmospheric Research Program Global Experiment (FGGE) IIIb data set in the 1978 to 1979 winter, a potential vorticity (PV) index was defined as a measure of the zonally averaged, mid-latitude PV gradient on the 300 K isentropic surface in the Northern Hemisphere. The evolution of that index and its relation to teleconnection patterns of 500 mb geopotential height anomaly are studied. The results of the temporal and spatial variation of blocking and cyclogenesis in the 1978 to 1979 winter and its relation to global and local PV gradients were obtained. Complex empirical orthogonal function (EOF) analyses were performed, using the same FGGE data set for the 1978 to 1979 winter, for a representative high latitude band and mid latitude band geopotential height anomalies at 500 mb, phi sub h, phi sub m, and PV gradient at 300 K, delta(Q), at each longitude for the three month period. The focus of current research is the following: (1) to perform Fourier analyses for the first three EOF's of phi sub h, phi sub m, and delta(Q) at given latitude bands, and to find the dominant wavenumbers and frequencies which are responsible for these EOF's; (2) to compare the results from EOF and Fourier analyses which will be used to explore the relations of blocking and cyclogensis with local and global PV gradients; and (3) to study the time dependence of the local PV gradients and relate it to the PV index vacillation cycles observed in the PV index cycle. Author

**N91-32673*#** California Univ., Davis. Atmospheric Science Program.
**USE OF SATELLITE DATA AND MODELING TO ASSESS THE INFLUENCE OF STRATOSPHERIC PROCESSES ON THE TROPOSPHERE c46**
Terrence Nathan *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 41-43 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04A

Over the past forty years, numerous linear stability studies have been performed in order to explain the origin and structure of observed waves in the atmosphere. Of these studies, only a small fraction have considered the stability of time-dependent, zonally varying flow or the influence of radiative-photochemical feedbacks on the stability of zonally uniform flow. The stability of such flows is described, and these flows may yield important information concerning the origin, structure, and transient time scales of free waves in the atmosphere. During the period 1990 to 1991, a beta-plane model that couples radiative transfer, ozone advection, and ozone photochemistry with the quasigeostrophic dynamical circulation was developed in order to study the diabatic effects of Newtonian cooling and ozone-dynamics interaction on

the linear stability of free planetary waves in the atmosphere. The stability of a basic state consisting of a westward-moving wave and a zonal mean jet was examined using a linearized, nondivergent barotropic model on sphere. The sensitivity of the stability of the flow to the strength and structure of the zonal jet was emphasized. The current research is focused on the following problems: (1) examination of the finite amplitude interactions among radiation, ozone, and dynamics; and (2) examination of the role of seasonal forcing in short-term climate variability. The plans for next year are presented. Author

**N91-32674*#** Pennsylvania State Univ., University Park. Dept. of Meteorology.

**NONLINEAR FEEDBACKS BETWEEN STRATOCUMULUS AND SYNOPTIC-SCALE SYSTEMS**

John H. E. Clark and Hampton N. Shirer *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 45-46 (For primary document see N91-32660 24-47)

Avail: NTIS HC/MF A05 CSCL 04B

The research progress for FY-91 is presented. Wintertime and springtime stratocumulus observations for a number of 5-day periods were collected. Close correlations between the mean 850 and 500 mb trough positions and cloud cover over marine areas were found. A linear study of the radiatively-driven interaction between stratocumulus and synoptic-scale waves was completed. Shallow surface-bound traveling waves are created that are strongly dependent on the phase relation between cloud and low-level flow. A nonlinear model is now under development that will permit a more detailed investigation of these interactions. Finally, a nonlinear study of the modifications of the background flow by boundary layer roll vortices was revised for submission for publication. The research plans for FY-92 are included. Author

**N91-32675*#** Colorado Univ., Boulder. Dept. of Astrophysical, Planetary, and Atmospheric Sciences.

**LABORATORY AND THEORETICAL MODELS OF PLANETARY-SCALE INSTABILITIES AND WAVES Abstract Only c91**

John E. Hart and Juri Toomre *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 47 (For primary document see N91-32660 24-47)

Avail: NTIS HC/MF A05 CSCL 03B

Meteorologists and planetary astronomers interested in large-scale planetary and solar circulations recognize the importance of rotation and stratification in determining the character of these flows. The two outstanding problems of interest are: (1) the origins and nature of chaos in baroclinically unstable flows; and (2) the physical mechanisms responsible for high speed zonal winds and banding on the giant planets. The methods used to study these problems, and the insights gained, are useful in more general atmospheric and climate dynamic settings. Because the planetary curvature or beta-effect is crucial in the large scale nonlinear dynamics, the motions of rotating convecting liquids in spherical shells were studied using electrohydrodynamic polarization forces to generate radial gravity and centrally directed buoyancy forces in the laboratory. The Geophysical Fluid Flow Cell (GFFC) experiments performed on Spacelab 3 in 1985 were analyzed. The interpretation and extension of these results have led to the construction of efficient numerical models of rotating convection with an aim to understand the possible generation of zonal banding on Jupiter and the fate of banana cells in rapidly rotating convection as the heating is made strongly supercritical. Efforts to pose baroclinic wave experiments for future space missions using a modified version of the 1985 instrument have led us to develop theoretical and numerical models of baroclinic instability. Some surprising properties of both these models were discovered. Author

**N91-32676*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

**RESEARCH HIGHLIGHTS: JUNE 1990 - MAY 1991**

*In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 48-49 (For primary document see N91-32660 24-47)

Avail: NTIS HC/MF A05 CSCL 04B

Linear instability calculations at MSFC have suggested that the Geophysical Fluid Flow Cell (GFFC) should exhibit classic baroclinic instability at accessible parameter settings. Interest was in the mechanisms of transition to temporal chaos and the evolution of spatio-temporal chaos. In order to understand more about such transitions, high resolution numerical experiments for the physically simplest model of two layer baroclinic instability were conducted. This model has the advantage that the numerical code is exponentially convergent and can be efficiently run for very long times, enabling the study of chaotic attractors without the often devastating effects of low-order trunction found in many previous studies. Numerical algorithms for implementing an empirical orthogonal function (EOF) analysis of the high resolution numerical results were completed. Under conditions of rapid rotation and relatively low differential heating, convection in a spherical shell takes place as columnar banana cells wrapped around the annular gap, but with axes oriented along the axis of rotation; these were clearly evident in the GFFC experiments. The results of recent numerical simulations of columnar convection and future research plans are presented. Author

**N91-32677*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

**AIRBORNE CW LIDAR MEASUREMENTS OF ATMOSPHERIC BACKSCATTER AT 9.1 AND 10.6 MICRONS**

William D. Jones *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 51-52 (For primary document see N91-32660 24-47)

Avail: NTIS HC/MF A05 CSCL 04B

Atmospheric backscatter data collected during the Global Backscatter Experiment (GLOBE) 1 and GLOBE 2 Survey Missions were partially analyzed. These data were collected using the MSFC's 9.1 and 10.6 micron focused continuous wave CO2 coherent detection lidars. In general, both data sets have shown reasonably good agreement with data collected by the JPL's pulsed nadir and zenith viewing CO2 system and with the ground-based, pulsed CO2 system operated by NOAA's Wave Propagation Laboratory. Generally good agreement was also noted with IR backscatter estimates produced by Mie calculations using aerosol size and composition data obtained during the GLOBE 1 and GLOBE 2 missions. The focus of current research and plans for future research are presented. Author

**N91-32678*#** New Mexico Inst. of Mining and Technology, Socorro.

**ELECTRIFICATION IN WINTER STORMS AND THE ANALYSIS OF THUNDERSTORM OVERFLIGHT**

Marx Brook *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 53-55 (For primary document see N91-32660 24-47)

(Grant NAG8-66)

Avail: NTIS HC/MF A05 CSCL 04B

The emergence of 24 hr operational lightning detection networks has led to the finding that positive lightning strokes, although still much fewer in number than the normal negative strokes, are present in summer and winter storms. Recent papers address the importance of understanding the meteorological conditions which lead to a dominance of one polarity of stroke over another; the appearance of positive strokes at the end of a storm appeared to presage the end-of-storm downdraft and subsidence leading to downburst activity. It is beginning to appear that positive strokes may be important meteorological indicators. Significant research accomplishments on the following topics are addressed: (1) a study to verify that the black boxes used in the lightning networks to detect both negative and positive strokes to ground were accurate; (2) the use of slow tails to determine the polarity of distant lightning; (3) lightning initiation in winter vs. summer storms; (4) the upgrade of sensors for the measurement

of electric field signals associated with lightning; (5) the analysis of lightning flash records from storms between 40 and 125 km from the sensor; and (6) an interesting aspect of the initiation process which involves the physical processes driving the stepped leader. The focus of current research and future research plans are presented. Author

**N91-32679*#** National Oceanic and Atmospheric Administration, Boulder, CO.
**NOAA BACKSCATTER STUDIES c45**
Madison J. Post *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 57-59 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 13B

In the past year, NOAA has measured and analyzed another year's worth of backscatter over Boulder, CO. The average profile was computed from 80 satellite observations of backscatter spread throughout the year, using NOAA's CO2 coherent lidar operating at a wavelength of 10.59 microns. The seasonal averages show a familiar trend (highest backscattering in spring, perhaps due to Asian dust or biomass burning, and lowest backscattering in fall). The 1990 average profile was not significantly different from the 1988 or 1989 profiles, except that it displays a slight increase in the upper troposphere, perhaps due to the Redoubt Volcano. The NOAA's backscatter processing program (BETA) was refined to enable the calculation of gaseous absorption effects based on rawinsonde measurements, as well as using atmospheric models. NOAA participated in two intercomparisons of aerosol measuring instruments near Boulder, called FRLAB (Front Range Lidar, Aircraft, and Balloon Experiment). Considerable effort was also put into developing a multiagency science proposal to NASA headquarters to work with both JPL and NASA-Marshall to produce an airborne Doppler lidar facility for the DC-8. Author

**N91-32680*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**COMPUTER MODELING OF PULSED CO2 LASERS FOR LIDAR APPLICATIONS c36**
Gary D. Spiers, Martin E. Smithers, and Rom Murty (Alabama A & M Univ., Normal.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 61-62 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 20E

The experimental results will enable a comparison of the numerical code output with experimental data. This will ensure verification of the validity of the code. The measurements were made on a modified commercial CO2 laser. Results are listed as following. (1) The pulse shape and energy dependence on gas pressure were measured. (2) The intrapulse frequency chirp due to plasma and laser induced medium perturbation effects were determined. A simple numerical model showed quantitative agreement with these measurements. The pulse to pulse frequency stability was also determined. (3) The dependence was measured of the laser transverse mode stability on cavity length. A simple analysis of this dependence in terms of changes to the equivalent fresnel number and the cavity magnification was performed. (4) An analysis was made of the discharge pulse shape which enabled the low efficiency of the laser to be explained in terms of poor coupling of the electrical energy into the vibrational levels. And (5) the existing laser resonator code was changed to allow it to run on the Cray XMP under the new operating system. Author

**N91-32681*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**BETA MEASUREMENTS**
R. M. Schotland, A. J. Warren, and O. M. Funariu *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 63-64 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

The second year's results of the BETA project research are presented. The program is divided into two areas, aerosol modification and climatology in the trade wind region and the climatology of BETA (CO2) on remote mountain top locations. Limited data is available on the aerosol climatology of the marine free troposphere (MFT) in the trade wind region. In order to study the effects of cumulus convection on the MFT values of BETA, a cloud model was developed to simulate the evolution of a typical Pacific trade wind cumulus cloud. The stages involved in this development are outlined. The assembly of the major optical components of the lidar was made. Tests were run of the spectral bandwidth of the Synrad laser when a portion of the beam is mixed with a component which has traveled 450 meters corresponding to a delay of 1.5 microsecs. The bandwidth of the beat signal was measured to be 3 KHz. The data processing system based on a parallel processing filter bank analyzer using true time squaring detectors at each filter was completed. Author

**N91-32682*#** Florida State Univ., Tallahassee. Dept. of Meteorology.
**REMOTE SENSING OF WATER VAPOR FEATURES**
Henry E. Fuelberg *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 65-68 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

The three major objectives of the project are outlined: (1) to describe atmospheric water vapor features as functions of space and time; (2) to evaluate remotely sensed measurements of water vapor content; and (3) to study relations between fine-scale water vapor fields and convective activity. Data from several remote sensors were used. The studies used the GOES/VAS, HIS, and MAMS instruments have provided a progressively finer scale view of water vapor features. Author

**N91-32683*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**GLOBAL TEMPERATURE VARIATIONS**
Roy W. Spencer and John R. Christy (Alabama Univ., Huntsville.) *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 69-70 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

Intercalibration statistics of all Microwave Sounding Units (MSUs) operating through 1990 were computed and brightness temperature anomalies on various space and time scales were compiled for MSU channels 2 (troposphere) and 4 (lower stratosphere). A tropospheric retrieval was developed through combination of channel 2 data from various view angles across the MSU scan swath to achieve cancellation of the influence of the lower stratosphere, and much of the upper troposphere, on that channel. Radiosonde validation of the MSU channel 2 and tropospheric retrieval anomalies was performed with 10 years of data at all U.S. controlled stations. Author

**N91-32684*#** Remote Sensing Systems, Inc., Santa Rosa, CA.
**DERIVING EARTH SCIENCE PRODUCTS FROM SSM/I**
Frank J. Wentz *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 71-73 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

There are 3 components to this project. The first is the production of a quality controlled Level-1 data product for the Special Sensor Microwave Imager (SSM/I). Second is the generation of research quality ocean products. The 3rd component is studying the feasibility of obtaining both wind speed and wind direction from satellite microwave radiometers. The status of the three studies are discussed briefly. Time series of the SSM/I physical temperatures, receiver gains, and noise figures were studied in order to access the stability and integrity of the sensor data. A physically based retrieval algorithm was used to compute ocean products from the SSM/I Level-1 data. It simultaneously

finds the near surface wind speed, the columnar water vapor, and the columnar liquid water. A wind direction signal was found in the SSM/I brightness temperature. Author

**N91-32685*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**WETNET: USING SSM/I DATA INTERACTIVELY FOR GLOBAL DISTRIBUTION OF RAINFALL AND PRECIPITABLE WATER**
Edward J. Zipser and James P. McGuirk *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 75 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

By completing hardware installation, preparing for comparative studies of SSM/I, radar, and lightning data, it is believed that this will be a powerful combination for evaluating the global distribution of tropical rainfall, and the vertical distribution of latent heating, with strong application to algorithms for use on TRMM, EOS-A, and future GOES spacecraft. Potential data bases will be surveyed, about 5 case studies with surface rainfall, radar, lightning, and sounding data will be identified. SSM/I algorithms will be used to identify convective regions of MCSs. A catalog will be developed of the global profile of heavy tropical rainfall, and how these zones are organized within larger tropical weather systems. Beginning with the first few months of SSM/I data distributed over WetNet, SSM/I radiances will be compared with TOVS radiance (moisture and thermal) and OLR observations. The purpose is to improve understanding of how real world water vapor profiles in the tropical atmosphere are perceived by SSM/I precipitable water algorithm and, at the same time, by the TOVS water vapor channel. Author

**N91-32686*#** Florida State Univ., Tallahassee. Dept. of Meteorology.
**OBSERVING SYSTEM SIMULATION EXPERIMENTS FOR THE LASER ATMOSPHERIC WIND SOUNDER USING GLOBAL SPECTRAL MODEL**
Gregg Rohaly and T. N. Krishnamurti *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 77-81 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

Fundamental to improving the understanding of the total Earth system are increased and improved observations. In the coming decade several spaceborne instrumented platforms will be constructed and implemented. These platforms will, in large, be housing the NASA Earth Observing System (EOS) instrument suite. One of the proposed instruments is a wind profiling system which is currently referred to as the Laser Atmospheric Wind Sounder (LAWS). This instrument will use a CO2 Doppler lidar wind profiler to give wind measurements with a vertical and horizontal resolution which has yet to be seen globally. The LAWS instrument is now a candidate for launch on a NASA EOS-B platform and is fundamental to increasing our understanding of Earth system science. The LAWS data sets will form an integral component of the temporally continuous data base needed for research of the coupled climate systems. This instrument's observations will aid in giving an improved description of the atmospheric circulation, including the transports of energy, momentum, moisture, trace gases, and aerosols. Also, the wind data will be assimilated and used as the initial state for many global forecast models at various operational centers. Results of system simulation experiments are discussed, and future experiments are described. Author

**N91-32687*#** Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
**NONLINEAR DYNAMICS OF GLOBAL ATMOSPHERIC AND EARTH-SYSTEM PROCESSES** **c46**
Barry Saltzman, Wesley Ebisuzaki, Kirk A. Maasch, Robert Oglesby, and Lionel Pandolfo *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 83-84 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04A

General Circulation Model (GCM) studies of the atmospheric response to change boundary conditions are discussed. Results are reported on an extensive series of numerical studies based on the National Center for Atmospheric Research (NCAR) Community Climate Model (CCM) general circulation model. In these studies the authors determined the response to systematic changes in atmospheric CO2 ranging from 100 to 1000 ppm; to changes in the prescribed sea surface temperature (SST) in the Gulf of Mexico, such as occurred during the deglaciation phase of the last ice age; to changes in soil moisture over North America; and to changes in sea ice extent in the Southern Hemisphere. Study results show that the response of surface temperature and other variables is nearly logarithmic, with lower levels of CO2 implying greater sensitivity of the atmospheric state to changes in CO2. It was found that the surface temperature of the Gulf of Mexico exerts considerable control over the storm track and behavior of storm systems over the North Atlantic through its influence on evaporation and the source of latent heat. It was found that reductions in soil moisture can play a significant role in amplifying and maintaining North American drought, particularly when a negative soil moisture anomaly prevails late in the spring. Author

**N91-32688*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**THE ROLE OF THE SEA-SURFACE TEMPERATURE DISTRIBUTION ON NUMERICALLY SIMULATED CYCLOGENESIS DURING ERICA**
William M. Lapenta, Donald J. Perkey, Carl W. Kreitzberg (Drexel Univ., Philadelphia, PA.), and Franklin R. Robertson *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 85-87 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

The goal was to quantify the extent to which a sea surface temperature (SST) front can influence cyclogenesis. The approach was to use the Drexel Limited-Area Mesoscale Prediction System (LAMPS) dynamical model to simulate cyclogenesis over various SST fields. Research during the past year focused on the development and testing of a four dimensional data assimilation (FDDA) technique within LAMPS. The technique is a continuous dynamical assimilation where forcing terms are added to the governing model equations to gradually nudge the model solution toward a gridded analysis. Here, the nudging is used as a dynamic initialization tool during a 12 hour preforecast to generate model balanced initial conditions for a subsequent 24 hour numerical prediction. Tests were performed to determine which variables to nudge and how to specify the four dimensional weighting function used to scale the nudging terms. To date, optimal results were obtained by nudging the u and v components of the wind along with the potential temperature. The weighting function ranged from 0 to 1 and varies in time as a quadratic polynomial. It was initialized at 0, reached its maximum at 9 hours into the preforecast, and fell back at 0 to 12 hours. The nudging terms are included in the model equations for all grid points except those within the model predicted oceanic boundary layer. This design attempts to confine changes imposed by the specified SST field to the oceanic boundary layer during the preforecast period. Author

**N91-32689*#** Alabama Univ., Huntsville.
**MONITORING, ANALYZING, AND MODELING GLOBAL CLIMATE**
John R. Christy *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 89-91 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

Diabatic heating rate estimates as residuals of the dry thermodynamic equation were generated for May 1, 1985 to December 1989 in pentad resolution. Published results show moderate correlations (approx. .6) between heating rate and

outgoing long wave radiation for periods under 90 days in the tropics and many extratropical locations. Nine years of simulation with the Community Climate Model 1 (CCM1) using R15 and observed sea surface temperatures shows that the model retains significantly more heat at the surface and in the free atmosphere than does the actual earth system. A post-processor for the CCM1, with capabilities to produce simulated microwave sounding unit (MSU) brightness temperatures was written. Techniques were refined considerably and validation studies were carried out to verify the globally distributed free atmosphere temperature anomalies derived from MSU data. The precision is such that detailed, long-term climate monitoring is well within the capability of these data. Author

**N91-32690*#** Texas A&M Univ., College Station. Dept. of Meteorology.
**TROPICAL PACIFIC MOISTURE VARIABILITY**
James P. McGuirk *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 93-95 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04B

The research objectives were to describe synoptic scale variability of moisture over the tropical Pacific Ocean and the systems leading to this variability, to implement satellite analysis procedures to accomplish that objective, to incorporate additional satellite information into operational analysis/forecast systems at the National Meteorological Center (NMC), and to synthesize knowledge gained from satellite observations through diagnosis and numerical models. In the past year, three significant satellite data analysis tasks were accomplished: comparisons for upwelling radiance fields for 1983 and 1984 were completed for the purpose of testing the sensitivity of water vapor/greenhouse feedback to local sea surface temperature variations; the interaction between tropical plumes, wave features over Central America, traveling waves in the upper tropospheric tropics, and the tropical interseasonal oscillation was examined; and planning and early efforts on the construction of a model and the infrared based climatology of daily precipitable water was completed. Research on tropical plume mechanisms included is briefly discussed. Author

**N91-32691*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**SOUTH PACIFIC CONVERGENCE ZONE AND GLOBAL SCALE CIRCULATIONS (JUL. 1987 - JUL. 1991). OBSERVATIONAL AND MODELING STUDIES OF HEAT, MOISTURE, PRECIPITATION, AND GLOBAL-SCALE CIRCULATION PATTERNS (JUL. 1990 - JUL. 1993)**
Dayton G. Vincent (Purdue Univ., West Lafayette, IN.) and Franklin R. Robertson *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 97-99 (For primary document see N91-32660 24-47)
(Contract NAS8-37127; NAG8-836)
Avail: NTIS HC/MF A05 CSCL 04B

Several research projects were worked on between August 1990 and May 1991. Topics covered included observational and modeling studies of relationships between tropical heat sources and subtropical jet streams, the intraseasonal (30 to 60 day) oscillation near the equator, and precipitation over tropical oceans. Current research activities and plans for the coming year are outlined. Author

**N91-32692*#** Purdue Univ., West Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
**SYNOPTIC/PLANETARY-SCALE INTERACTIONS AND BLOCKING OVER THE NORTH ATLANTIC OCEAN** **c46**
Phillip J. Smith, Mary A. Uhl, Anthony R. Lupo, Gregory L. Lamberty, and Melinda Hunter *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 101-102 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 04A

One segment of work in the past year focused on the diagnosis of a major blocking anticyclone and its interacting synoptic scale circulations that occurred during January 1979 over the North Atlantic Ocean. Another segment focused on the diagnosis of a second explosive cyclone development that occurred over the southeastern United States during the time of block formation. The diagnoses were accomplished using the diagnostic relationship known as the Zwack-Okossi (Z-O) development equation. Results indicate that in both cyclone cases the development occurred as a result of the favorable influence of positive vorticity advection, warm air advection, and latent heat release and ceased when one or more of these influences diminished. The advantages of the Z-O equation are described. Author

**N91-32693*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
**THE 1991 INTERNATIONAL AEROSPACE AND GROUND CONFERENCE ON LIGHTNING AND STATIC ELECTRICITY, VOLUME 2**
Aug. 1991 459 p Conference held in Cocoa Beach, FL, 16-19 Apr. 1991; sponsored in part by NASA, the National Interagency Coordination Group, and Florida Inst. of Tech.
(NASA-CP-3106-Vol-2; NAS 1.55:3106-Vol-2) Avail: NTIS HC/MF A20 CSCL 04B

The proceedings of the conference are reported. The conference focussed on lightning protection, detection, and forecasting. The conference was divided into 26 sessions based on research in lightning, static electricity, modeling, and mapping. These sessions spanned the spectrum from basic science to engineering, concentrating on lightning prediction and detection and on safety for ground facilities, aircraft, and aerospace vehicles. For individual titles, see N91-32694 through N91-32737.

**N91-32694*#** Electrical Research Association, Leatherhead (England).
**LIGHTNING INDUCED CURRENTS IN AIRCRAFT WIRING USING LOW LEVEL INJECTION TECHNIQUES** **c33**
E. G. Stevens and D. T. Jordan (Royal Aircraft Establishment, Farnborough, England ) *In* NASA, Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09C

Various techniques were studied to predict the transient current induced into aircraft wiring bundles as a result of an aircraft lightning strike. A series of aircraft measurements were carried out together with a theoretical analysis using computer modeling. These tests were applied to various aircraft and also to specially constructed cylinders installed within coaxial return conductor systems. Low level swept frequency CW (carrier waves), low level transient and high level transient injection tests were applied to the aircraft and cylinders. Measurements were made to determine the transfer function between the aircraft drive current and the resulting skin currents and currents induced on the internal wiring. The full threat lightning induced transient currents were extrapolated from the low level data using Fourier transform techniques. The aircraft and cylinders used were constructed from both metallic and CFC (carbon fiber composite) materials. The results show the pulse stretching phenomenon which occurs for CFC materials due to the diffusion of the lightning current through carbon fiber materials. Transmission Line Matrix modeling techniques were used to compare theoretical and measured currents. Author

**N91-32695*#** New Mexico Inst. of Mining and Technology, Socorro.
**OBSERVATIONS OF LIGHTNING PROCESSES USING VHF RADIO INTERFEROMETRY**
C. T. Rhodes, X. M. Shao, P. R. Krehbiel, and R. Thomas *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 13 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

A single station, multiple baseline radio interferometer was used to locate the direction of VHF radiation from lightning discharges with microsec time resolution. Radiation source directions and electric field waveforms were analyzed for various types of breakdown events. These include initial breakdown and K type events of in-cloud activity, and the leaders of initial and subsequent strokes to ground and activity during and following return strokes. Radiation during the initial breakdown of a flash and in the early stages of initial leaders to ground is found to be similar. In both instances, the activity consists of localized bursts of radiation that are intense and slow moving. Motion within a given burst is unresolved by the interferometer. Radiation from in-cloud K type events is essentially the same as that from dart leaders; in both cases it is produced at the leading edge of a fast moving streamer that propagates along a well defined, often extensive path. K type events are sometimes terminated by fast field changes that are similar to the return stroke initiated by dart leaders; such K type events are the in-cloud analog of the dart leader return stroke process. Author

**N91-32696*#** Norwegian Defence Research Establishment, Kjeller.

**THE PHYSICS OF THE OSCILLATING LIGHTNING**

Per B. Storebo *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)

Avail: NTIS HC/MF A20 CSCL 04B

The lightning is proposed to start in a limited region of electric breakdown field. A growing charge pool in a cumulonimbus cloud is likely to produce such a field in its outer layers. When the field is not aligned with the potential surfaces, the electric force pushes positive charge in one direction and negative in the opposite. Self inductance develops and an embryo open electric circuit is born. Oscillations swiftly grow in strength when potential energy of the cloud is released. The channel extends in steps during those cycle stages where charge is crammed into the channel terminals. Electrostatic consequences of a narrow conductor among the cloud charges are computed. The conductor is charged by influence to such a degree that the charge is bound to leak out to the ambient air and appear as a charge sheath some distance off the channel. Ample energy is released to sustain the oscillations. The period increases with channel length and agrees well with observed time between steps. A ground strike leads to a shock pulse travelling up the channel. Author

**N91-32697*#** Florida Univ., Gainesville. Dept. of Electrical Engineering.

**A SYSTEM FOR MAPPING SOURCES OF VHF AND ELECTRIC FIELD PULSES FROM IN-CLOUD LIGHTNING AT KSC**

Ewen M. Thomson and Pedro J. Medelius *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)

Avail: NTIS HC/MF A20 CSCL 04B

The literature concerning VHF radiation and wideband electric fields from in-cloud lightning is reviewed. VHF location systems give impressive radio images of lightning in clouds with high spatial and temporal resolution. Using systems based on long and short baseline time-or-arrival and interferometry, workers have detected VHF sources that move at speeds of 10(exp 5) to 10(exp 8) m/s. The more slowly moving sources appear to be associated with channel formation but the physical basis for the higher speeds is not clear. In contrast, wideband electric fields are directly related to physical parameters such as current and tortuosity. A long baseline system is described to measure simultaneously VHF radiation and wideband electric fields at five stations at Kennedy Space Center. All signals are detected over remote, isolated ground planes with fiber optics for data transmission. The modification of this system to map rapidly varying dE/dt pulses is discussed. Author

**N91-32698*#** Nis Univ. (Yugoslavia).

**A NEW APPROACH TO THE DETERMINATION OF THE STRIKING DISTANCE FROM THE LIGHTNING CHANNEL PHOTOS**

A. Vorgucic and I. Mladenovic *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 6 p (For primary document see N91-32693 24-47)

Avail: NTIS HC/MF A20 CSCL 04B

The possible influence the stepped leader movement has on the value of the striking distance is studied. The numerical values of the striking distances are most frequently verified from the lightning channel photos. There is some explanations for dispersion of the striking distance which usually appear on tall structures. Unusually long striking distance may be influenced by the positive space charge or prior upward flashes. One more parameter which may have influence in estimation of the striking distance is a complex charge motion in the leader channel. Through introduction of two types of charge motions, possible shortening is shown of the striking distance seen on the lightning channel photos. Author

**N91-32699*#** Dassault (E. M.) Co., Saint Cloud (France).

**ELECTROMAGNETIC TOPOLOGY: CHARACTERIZATION OF INTERNAL ELECTROMAGNETIC COUPLING** **c32**

J. P. Parmantier, J. P. Aparicio, and F. Faure (Office National d'Etudes et de Recherches Aerospatiales, Paris, France ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 11 p Previously announced in IAA as A91-45613 (For primary document see N91-32693 24-47)

Avail: NTIS HC/MF A20 CSCL 20N

The main principles are presented of a method dealing with the resolution of electromagnetic internal problems: Electromagnetic Topology. A very interesting way is to generalize the multiconductor transmission line network theory to the basic equation of the Electromagnetic Topology: the BLT equation. This generalization is illustrated by the treatment of an aperture as a four port junction. Analytical and experimental derivations of the scattering parameters are presented. These concepts are used to study the electromagnetic coupling in a scale model of an aircraft, and can be seen as a convenient means to test internal electromagnetic interference. Author

**N91-32700*#** Centre d'Etudes de Gramat (France).

**A REAL SCALE SIMULATOR FOR HIGH FREQUENCY LEMP** **c09**

D. Gauthier and D. Serafin *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 11 p Sponsored in part by Direction des Recherches, Etudes et Techniques (DRET) (For primary document see N91-32693 24-47)

Avail: NTIS HC/MF A20 CSCL 14B

The real scale simulator is described which was designed by the Centre d'Etudes de Gramat (CEG) to study the coupling of fast rise time Lightning Electromagnetic pulse in a fighter aircraft. The system capability of generating the right electromagnetic environment was studied using a Finite Difference Time Domain (FDTD) computer program. First, data of inside stresses are shown. Then, a time domain and a frequency domain approach is exposed and compared. Author

**N91-32701*#** Centre d'Etudes de Gramat (France).

**A THEORETICAL ANALYSIS OF THE ELECTROMAGNETIC ENVIRONMENT OF THE AS330 SUPER PUMA HELICOPTER EXTERNAL AND INTERNAL COUPLING** **c32**

F. Flourens, T. Morel, D. Gauthier, and D. Serafin *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 12 p Sponsored in part by Direction des Recherches, Etudes et Techniques (DRET) (For primary document see

N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 20N

Numerical techniques such as Finite Difference Time Domain (FDTD) computer programs, which were first developed to analyze the external electromagnetic environment of an aircraft during a wave illumination, a lightning event, or any kind of current injection, are now very powerful investigative tools. The program called GORFF-VE, was extended to compute the inner electromagnetic fields that are generated by the penetration of the outer fields through large apertures made in the all metallic body. Then, the internal fields can drive the electrical response of a cable network. The coupling between the inside and the outside of the helicopter is implemented using Huygen's principle. Moreover, the spectacular increase of computer resources, as calculations speed and memory capacity, allows the modellization structures as complex as these of helicopters with accuracy. This numerical model was exploited, first, to analyze the electromagnetic environment of an in-flight helicopter for several injection configurations, and second, to design a coaxial return path to simulate the lightning aircraft interaction with a strong current injection. The E field and current mappings are the result of these calculations. Author

**N91-32702*#** National Research Council of Canada, Ottawa (Ontario). Electromagnetic Protection Group.
**THREE-DIMENSIONAL TIME DOMAIN MODEL OF LIGHTNING INCLUDING CORONA EFFECTS**
Andrew S. Podgorski *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 7 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

A new 3-D lightning model that incorporates the effect of corona is described for the first time. The new model is based on a Thin Wire Time Domain Lightning (TWTDL) Code developed previously. The TWTDL Code was verified during the 1985 and 1986 lightning seasons by the measurements conducted at the 553 m CN Tower in Toronto, Ontario. The inclusion of corona in the TWTDL code allowed study of the corona effects on the lightning current parameters and the associated electric field parameters. Author

**N91-32703*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
**SURFACE WIND CONVERGENCE AS A SHORT-TERM PREDICTOR OF CLOUD-TO-GROUND LIGHTNING AT KENNEDY SPACE CENTER: A FOUR-YEAR SUMMARY AND EVALUATION**
Andrew I. Watson, Ronald L. Holle, Raul E. Lopez (National Severe Storms Lab., Boulder, CO.), and James R. Nicholson *In its* The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

Since 1986, USAF forecasters at NASA-Kennedy have had available a surface wind convergence technique for use during periods of convective development. In Florida during the summer, most of the thunderstorm development is forced by boundary layer processes. The basic premise is that the life cycle of convection is reflected in the surface wind field beneath these storms. Therefore the monitoring of the local surface divergence and/or convergence fields can be used to determine timing, location, longevity, and the lightning hazards which accompany these thunderstorms. This study evaluates four years of monitoring thunderstorm development using surface wind convergence, particularly the average over the area. Cloud-to-ground (CG) lightning is related in time and space with surface convergence for 346 days during the summers of 1987 through 1990 over the expanded wind network at KSC. The relationships are subdivided according to low level wind flow and midlevel moisture patterns. Results show a one in three chance of CG lightning when a convergence event is identified. However, when there is no convergence, the chance of CG lightning is negligible. Author

**N91-32704*#** Weather Wing ( 4th), Cape Canaveral AFS, FL. Detachment 11.
**ASSESSMENT AND FORECASTING OF LIGHTNING POTENTIAL AND ITS EFFECT ON LAUNCH OPERATIONS AT CAPE CANAVERAL AIR FORCE STATION AND JOHN F. KENNEDY SPACE CENTER**
J. Weems, N. Wyse, J. Madura, M. Secrist, and C. Pinder *In* NASA, Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 11 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

Lightning plays a pivotal role in the operation decision process for space and ballistic launches at Cape Canaveral Air Force Station and Kennedy Space Center. Lightning forecasts are the responsibility of Detachment 11, 4th Weather Wing's Cape Canaveral Forecast Facility. These forecasts are important to daily ground processing as well as launch countdown decisions. The methodology and equipment used to forecast lightning are discussed. Impact on a recent mission is summarized. Author

**N91-32705*#** United Kingdom Atomic Energy Authority, Culham (England). Lightning Test and Technology.
**MEASUREMENTS OF SOME PARAMETERS OF THERMAL SPARKS WITH RESPECT TO THEIR ABILITY TO IGNITE AVIATION FUEL/AIR MIXTURES**
S. J. Haigh, C. J. Hardwick, and R. E. Baldwin *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

A method used to generate thermal sparks for experimental purposes and methods by which parameters of the sparks, such as speed, size, and temperature, were measured are described. Values are given of the range of such parameters within these spark showers. Titanium sparks were used almost exclusively, since it is particles of this metal which are found to be ejected during simulation tests to carbon fiber composite (CFC) joints. Tests were then carried out in which titanium sparks and spark showers were injected into JP4/(AVTAG F40) mixtures with air. Single large sparks and dense showers of small sparks were found to be capable of causing ignition. Tests were then repeated using ethylene/air mixtures, which were found to be more easily ignited by thermal sparks than the JP4/ air mixtures. Author

**N91-32706*#** Atmospheric Research Systems, Inc., Palm Bay, FL.
**THE EFFECT OF THE EARTH'S OBLATE SPHEROID SHAPE ON THE ACCURACY OF A TIME-OF-ARRIVAL LIGHTNING GROUND STRIKE LOCATING SYSTEM**
Paul W. Casper and Rodney B. Bent *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 8 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

The algorithm used in previous technology time-of-arrival lightning mapping systems was based on the assumption that the earth is a perfect spheroid. These systems yield highly-accurate lightning locations, which is their major strength. However, extensive analysis of tower strike data has revealed occasionally significant (one to two kilometer) systematic offset errors which are not explained by the usual error sources. It was determined that these systematic errors reduce dramatically (in some cases) when the oblate shape of the earth is taken into account. The oblate spheroid correction algorithm and a case example is presented. Author

**N91-32707*#** Meteorological Office, Bracknell (England).
**EXPERIENCE GAINED IN OPERATION OF THE VLF ATD LIGHTNING LOCATION SYSTEM**
Anthony C. L. Lee *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and

Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

The United Kingdom (UK) Meteorological Office's Very Low Frequency (VLF) Arrival Time Difference (ATD) System for long-range location of lightning flashes started automatic international issue of lightning-location products on 17 Jun. 1988. Data from before and after this formal start-date were carefully scrutinized to judge performance. Techniques for estimating location accuracy include internal consistency and comparisons against other systems. Other areas studied were range (up to several thousand km); detection efficiency, saturation effects in active situations, and communication difficulties (for this redundant system); and spurious fix rate. Care was taken to assess the potential of the system, in addition to identifying the operational difficulties of the present implementation. Author

**N91-32708*#** Electricity Council Research Centre, Capenhurst (England).
**EXTENSION OF AND IMPROVEMENTS TO THE ERDC LOW FREQUENCY MAGNETIC DIRECTION FINDING SYSTEM**
M. I. Lees *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

In 1985, a three station direction finding lightning location system was established in the United Kingdom. A description of its evolution from an experimental system to a five station commercial system providing both on-line and historical location information is presented. A method of error reduction which enables simultaneous optimization of strike location and calculation of aerial twist error is described, together with results of the analysis of four station data from 1989. It is demonstrated that one station with a twist error can produce an apparent bearing dependent error in a station without errors. Application of the bearing corrections has significantly improved the accuracy of the system. Average location errors of better that 1 km can be achieved at a distance of 200 km from the stations. Author

**N91-32709*#** Academia Sinica, Beijing (China). Center for Space Science and Applied Research.
**AN ITERATIVE METHOD FOR OBTAINING THE OPTIMUM LIGHTNING LOCATION ON A SPHERICAL SURFACE**
Gao Chao and Ma Qiming *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 7 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

A brief introduction to the basic principles of an eigen method used to obtain the optimum source location of lightning is presented. The location of the optimum source is obtained by using multiple direction finders (DF's) on a spherical surface. An improvement of this method, which takes the distance of source-DF's as a constant, is presented. It is pointed out that using a weight factor of signal strength is not the most ideal method because of the inexact inverse signal strength-distance relation and the inaccurate signal amplitude. An iterative calculation method is presented using the distance from the source to the DF as a weight factor. This improved method has higher accuracy and needs only a little more calculation time. Some computer simulations for a 4DF system are presented to show the improvement of location through use of the iterative method. Author

**N91-32710*#** Manchester Coll. of Science and Technology (England). Dept. of Physics.
**COMPARISON OF LIGHTNING LOCATION DATA AND POLARISATION RADAR OBSERVATIONS OF CLOUDS**
A. J. Illingworth and M. I. Lees (Electricity Council Research Centre, Capenhurst, England ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
(Grants USAF-SPC-90-4005; NERC-GR3/5896)
Avail: NTIS HC/MF A20 CSCL 04B

Simultaneous observations of both the precipitation and the lightning associated with thunderstorms show that the lightning is within 3 km of the maximum precipitation echo. The intensity and type of the precipitation is observed with 500 m spatial accuracy using an S-band polarization radar and the position of the lightning is inferred from a low frequency magnetic direction finding location system. Empirical adjustment to the angles using the redundancy of the lightning data reduce this error. Radar echoes above 45dBZ may be caused by soft hail or hailstones, but similarly intense echoes may result from melting snow. The data show that a new polarization radar parameter, the linear depolarization ratio, can distinguish between soft hail and melting snow, and that the intense radar echoes associated with melting snow pose no threat of lightning. A lightning risk only exists when the radar indicates that the clouds contain soft hail or hailstones. Author

**N91-32711*#** Arizona Univ., Tucson. Inst. of Atmospheric Physics.
**THE SPATIAL VARIATIONS OF LIGHTNING DURING SMALL FLORIDA THUNDERSTORMS**
Timothy D. Oram and E. Philip Krider *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

Networks of field mills (FM's) and lightning direction finders (LDF's) were used to locate lightning over the NASA KSC on three storm days. Over 90 percent of all cloud-to-ground (CG) flashes that were detected by the LDF's in the study area were also detected by the LDF's. About 17 percent of the FM CG events could be fitted to either a monopole or a dipole charge model. These projected FM charge locations are compared to LDF locations, i.e., the ground strike points. It was found that 95 percent of the LDF points are within 12 km of the FM charge, 75 percent are within 8 km, and 50 percent are within 4 km. For a storm on 22 Jul. 1988, there was a systematic 5.6 km shift between the FM charge centers and the LDF strike points that might have been caused by the meteorological structure of the storm. Author

**N91-32712*#** National Oceanic and Atmospheric Administration, Boulder, CO.
**WEAK POSITIVE CLOUD-TO-GROUND FLASHES IN NORTHEASTERN COLORADO**
Raul E. Lopez, Michael W. Maier, Juan A. Garcia-Miguel (Universidad Complutense, Madrid, Spain ), and Ronald L. Holle *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p Prepared in cooperation with Raytheon Co., Patrick AFB, FL (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

The frequency distributions of the peak magnetic field associated with the first detected return stroke of positive and negative cloud-to-ground (CG) flashes were studied using lightning data from northeastern Colorado. These data were obtained during 1985 with a medium-to-high gain network of three direction finders (DF's). The median signal strength of positive flashes was almost two times that of the negatives for flashes within 300 km of the DF's, which have an inherent detection-threshold bias that tends to discriminate against weak signals. This bias increases with range, and affects the detection of positive and negative flashes in different ways, because of the differing character of their distributions. Positive flashes appear to have a large percentage of signals clustered around very weak values that are lost to the medium-to-high gain Colorado Detection System very quickly with increasing range. The resulting median for positive signals could thus appear to be much larger than the median for negative signals, which are more clustered around intermediate values. When only flashes very close to the DF's are considered, however, the two

distributions have almost identical medians. The large percentage of weak positive signals detected close to the DF's has not been explored previously. They have been suggested to come from intracloud discharges and thus are improperly classified as CG flashes. Evidence in hand, points to their being real positive, albeit weak CG flashes. Whether or not they are real positive ground flashes, it is important to be aware of their presence in data from magnetic DF networks. Author

**N91-32713*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
**LIGHTNING MAPPING SYSTEM**
C. Lennon and L. Maier *In its* The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

A Lightning Detection and Ranging (LDAR) System is being implemented at KSC in Florida. The first operational use is expected in the late summer of 1991. The system is designed to map the location of in-cloud and cloud-to-ground lightning based on the time of arrival (TOA) of electromagnetic radiation. The system detects very high frequency (VHF) radiation and designed to map the volumetric extent of lightning. The system implements two independent antenna arrays to provide a fast data quality check, as necessary for a real-time warning system. The system performance goals and a comparison with a similar system implemented in the mid-1970's is made. Author

**N91-32714*#** EMC Science Center, Inc., West Conshohocken, PA.
**LIGHTNING TESTING AT THE SUBSYSTEM LEVEL**
Frank Luteran *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 6 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

Testing at the subsystem or black box level for lightning hardness is required if system hardness is to be assured at the system level. The often applied philosophy of lighting testing only at the system level leads to extensive end of the line design changes which result in excessive costs and time delays. In order to perform testing at the subsystem level two important factors must be defined to make the testing simulation meaningful. The first factor is the definition of the test stimulus appropriate to the subsystem level. Application of system level stimulations to the subsystem level usually leads to significant overdesign of the subsystem which is not necessary and may impair normal subsystem performance. The second factor is the availability of test equipment needed to provide the subsystem level lightning stimulation. Equipment for testing at this level should be portable or at least movable to enable efficient testing in a design laboratory environment. Large fixed test installations for system level tests are not readily available for use by the design engineers at the subsystem level and usually require special operating skills. The two factors, stimulation level and test equipment availability, must be evaluated together in order to produce a practical, workable test standard. The neglect or subordination of either factor will guarantee failure in generating the standard. It is not unusual to hear that test standards or specifications are waived because a specified stimulation level cannot be accomplished by in-house or independent test facilities. Determination of subsystem lightning simulation level requires a knowledge and evaluation of field coupling modes, peak and median levels of voltages and currents, bandwidths, and repetition rates. Practical limitations on test systems may require tradeoffs in lightning stimulation parameters in order to build practical test equipment. Peak power levels that can be generated at specified bandwidths with standard electrical components must be considered in the design and costing of the test system. Stimulation tests equipment and test methods are closely related and must be considered a test system for lightning simulation. A non-perfect specification that can be reliably and repeatedly applied at the subsystem test level is more desirable than a perfect specification that cannot be applied at all. Author

**N91-32715*#** Computer Resource Management, Inc., Atlantic City, NJ.
**IMPLEMENTATION OF THE FAA RESEARCH AND DEVELOPMENT ELECTROMAGNETIC DATABASE**
R. L. McDowall, D. J. Grush, D. M. Cook, and M. S. Glynn (Federal Aviation Administration, Atlantic City, NJ.) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 13 p Previously announced as N91-23674 (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

The Idaho National Engineering Laboratory (INEL) has been assisting the FAA in developing a database of information about lightning. The FAA Research and Development Electromagnetic Database (FRED) will ultimately contain data from a variety of airborne and ground-based lightning research projects. An outline of the data currently available in FRED is presented. The data sources which the FAA intends to incorporate into FRED are listed. In addition, it describes how the researchers may access and use the FRED menu system. Author

**N91-32716*#** United Kingdom Atomic Energy Authority, Culham (England). Lightning Test and Technology.
**THE NEW SECTION 23 OF DO160C/ED14C LIGHTNING TESTING OF EXTERNALLY MOUNTED ELECTRICAL EQUIPMENT** **c33**
B. J. C. Burrows *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

The new Section 23 is introduced which has only very recently been fully approved by the RTCA for incorporation into the first revision of DO160C/ED14C. Full threat lightning direct effects testing of equipment is entirely new to DO160, the only existing lightning testing is transient testing for LRU's (Line Replaceable Units) by pin or cable bundle injection methods, for equipment entirely contained within the airframe and assumed to be unaffected by direct effects. This testing required transients of very low amplitude compared with lightning itself, whereas the tests now to be described involve full threat lightning testing, that is using the previously established severe parameters of lightning appropriate to the Zone, such as 200 kA for Zone 1A as in AC20-136. Direct effects (i.e., damage) testing involves normally the lightning current arc attaching to the object under test (or very near to it) so submitting it to full potential for the electric, mechanical, thermal and shock damage which is caused by high current arcing. Since equipment for any part of the airframe require qualification, tests to demonstrate safety of equipment in fuel vapor regions of the airframe are also included. Author

**N91-32717*#** Lightning Technologies, Inc., Pittsfield, MA.
**DESIGN OF LIGHTNING PROTECTION FOR A FULL-AUTHORITY DIGITAL ENGINE CONTROL** **c07**
M. Dargi, E. Rupke, and K. Wiles *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lighnting and Static Electricity, Volume 2 Aug. 1991 12 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 21E

The steps and procedures are described which are necessary to achieve a successful lightning-protection design for a state-of-the-art Full-Authority Digital Engine Control (FADEC) system. The engine and control systems used as examples are fictional, but the design and verification methods are real. Topics discussed include: applicable airworthiness regulation, selection of equipment transient design and control levels for the engine/airframe and intra-engine segments of the system, the use of cable shields, terminal-protection devices and filter circuits in hardware protection design, and software approaches to minimize upset potential. Shield terminations, grounding, and bonding are

also discussed, as are the important elements of certification and test plans, and the role of tests and analyses. Also included are examples of multiple-stroke and multiple-burst testing. A review of design pitfalls and challenges, and status of applicable test standards such as RTCA DO-160, Section 22, are presented. Author

**N91-32718*#** Lightning Technologies, Inc., Pittsfield, MA.
**CERTIFICATION OF LIGHTNING PROTECTION FOR A FULL-AUTHORITY DIGITAL ENGINE CONTROL c07**
M. Dargi, E. Rupke, and K. Wiles *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 21E

FADEC systems present many challenges to the lightning protection engineer. Verification of the protection-design adequacy for certification purposes presents additional challenges. The basic requirements of the certification plan of a FADEC is to demonstrate compliance with Federal Airworthiness Regulations (FAR) 25.1309 and 25.581. These FARs are intended for transport aircraft, but there are equivalent sections for general aviation aircraft, normal and transport rotorcraft. Military aircraft may have additional requirements. The criteria for demonstration of adequate lightning protection for a FADEC systems include the procedures outlined in FAA Advisory Circular (AC) 20-136, Protection of aircraft electrical/electronic systems against the indirect effects of lightning. As FADEC systems, including the interconnecting wiring, are generally not susceptible to direct attachment of lightning currents, the verification of protection against indirect effects is primarily described. Author

**N91-32719*#** Voeikov Main Geophysical Observatory, Leningrad (USSR).
**ON ERROR SOURCES DURING AIRBORNE MEASUREMENTS OF THE AMBIENT ELECTRIC FIELD c33**
B. F. Evteev *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 11 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

The principal sources of errors during airborne measurements of the ambient electric field and charge are addressed. Results of their analysis are presented for critical survey. It is demonstrated that the volume electric charge has to be accounted for during such measurements, that charge being generated at the airframe and wing surface by droplets of clouds and precipitation colliding with the aircraft. The local effect of that space charge depends on the flight regime (air speed, altitude, particle size, and cloud elevation). Such a dependence is displayed in the relation between the collector conductivity of the aircraft discharging circuit - on one hand, and the sum of all the residual conductivities contributing to aircraft discharge - on the other. Arguments are given in favor of variability in the aircraft electric capacitance. Techniques are suggested for measuring from factors to describe the aircraft charge. Author

**N91-32720*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**LIGHTNING TO THE UPPER ATMOSPHERE: A VERTICAL LIGHT PULSE FROM THE TOP OF A THUNDERSTORM AS SEEN BY A PAYLOAD BAY TV CAMERA OF THE SPACE SHUTTLE**
William L. Boeck, Otha H. Vaughan, Jr., Richard Blakeslee, Bernard Vonnegut, Marx Brook, and John McKune (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

An examination and preliminary analysis of video images of thunderstorms as seen by a payload bay TV camera of the Space Shuttle provided examples of lightning in the stratosphere above thunderstorms. These images were obtained on several recent Shuttle flights while conducting the Mesoscale Lightning Experiment (MLE). MLE was an experiment to obtain night time images from space of large storm complexes with lightning. These images are used to provide data for the design of specialized instrumentation which will provide quantitative measurements of global lightning. Eight video sequences were selected because they illustrate near vertical discharges in the stratosphere above thunderstorms. Although there are previous reports in the literature, these are the first images from the viewpoint of an orbiting spacecraft. The written material is primarily a companion to a video presentation. Author

**N91-32721*#** Indian Inst. of Tropical Meteorology, Poona.
**A STUDY OF POINT DISCHARGE CURRENT OBSERVATIONS IN THE THUNDERSTORM ENVIRONMENT AT A TROPICAL STATION DURING THE YEAR 1987 AND 1988**
G. K. Manohar, S. S. Kandalgaonkar, and S. M. Sholapurkar *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 11 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

The results of the measurements of point discharge current observations at Pune, India, during years 1987 and 1988 are presented by categorizing and studying their number of spells, polar current average durations, and current magnitudes in day-time and night-time conditions. While the results showed that the thunderstorm activity occupies far more day-time than the night-time the level of current magnitudes remains nearly the same in the two categories. Author

**N91-32722*#** Monroe Electronics, Inc., Lyndonville, NY.
**LT-23: THE FEEDBACK VIBRATING CAPACITOR FIELDMETER c33**
James R. Vosteen and William E. Vosteen *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 13 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

A redesign effort was undertaken starting in the fall of 1988 to replace the Models 1019A and 1019B fieldmeter probes resulting in greatly improved performance. Extensive testing was conducted to confirm performance of the new design and to evaluate outdoor atmospheric applicability. The following subjects are discussed: theory of operation, design improvements, performance, proper use, and applications of the new intrinsically safe design. Author

**N91-32723*#** Academy of Sciences (USSR), Moscow. Branch of All-Union Electrotechnical Inst.
**OPTIMAL PARAMETERS OF LEADER DEVELOPMENT IN LIGHTNING**
N. I. Petrov and G. N. Petrova *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 4 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

The dependences between the different parameters of a leader in lightning are obtained theoretically. The physical mechanism of the instability leading to the formation of the streamer zone is proposed. The instability has the wave nature and is caused by the self-influence effects of the space charge. Using a stability condition of the leader propagation, a dependence is obtained between the current across the leader head and its velocity of motion. The dependence of the streamer zone length on the gap length is also obtained. It is shown that the streamer zone length is saturated with the increasing of the gap length. A comparison between the obtained dependences and the experimental data is presented. Author

**N91-32724*#** Hokkaido Univ. of Education, Iwamizawa (Japan). Dept. of Physics.
**ON CHARGING OF SNOW PARTICLES IN BLIZZARD**

Hisashi Shio *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

The causes of the charge polarity on the blizzard, which consisted of fractured snow crystals and ice particles, were investigated. As a result, the charging phenomena showed that the characteristics of the blizzard are as follows: (1) In the case of the blizzard with snowfall, the fractured snow particles drifting near the surface of snow field (lower area: height 0.3 m) had positive charge, while those drifting at higher area (height 2 m) from the surface of snow field had negative charge. However, during the series of blizzards two kinds of particles positively and negatively charged were collected in equal amounts in a Faraday Cage. It may be considered that snow crystals with electrically neutral properties were separated into two kinds of snow flakes (charged positively and negatively) by destruction of the snow crystals. (2) In the case of the blizzard which consisted of irregularly formed ice drops (generated by peeling off the hardened snow field), the charge polarity of these ice drops salting over the snow field was particularly controlled by the crystallographic characteristics of the surface of the snow field hardened by the powerful wind pressure. Author

**N91-32725*#** Army Missile Command, Redstone Arsenal, AL. Technical Test Center.
**A SIMULATED LIGHTNING EFFECTS TEST FACILITY FOR TESTING LIVE AND INERT MISSILES AND COMPONENTS**
Jeffery D. Craven, James A. Knaur, Truman W. Moore, Jr., and Thomas H. Shumpert (Auburn Univ., AL.) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 11 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

Details of a simulated lightning effects test facility for testing live and inert missiles, motors, and explosive components are described. The test facility is designed to simulate the high current, continuing current, and high rate-of-rise current components of an idealized direct strike lightning waveform. The Lightning Test Facility was in operation since May, 1988, and consists of: 3 separate capacitor banks used to produce the lightning test components; a permanently fixed large steel safety cage for retaining the item under test (should it be ignited during testing); an earth covered bunker housing the control/equipment room; a charge/discharge building containing the charging/discharging switching; a remotely located blockhouse from which the test personnel control hazardous testing; and interconnecting cables. Author

**N91-32726*#** Electro Magnetic Applications, Inc., Lakewood, CO.
**ELECTRON DISTRIBUTION FUNCTIONS IN ELECTRIC FIELD ENVIRONMENTS** **c72**
Terence H. Rudolph *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
(Contract DAAL02-89-C-0075)
Avail: NTIS HC/MF A20 CSCL 20H

The amount of current carried by an electric discharge in its early stages of growth is strongly dependent on its geometrical shape. Discharges with a large number of branches, each funnelling current to a common stem, tend to carry more current than those with fewer branches. The fractal character of typical discharges was simulated using stochastic models based on solutions of the Laplace equation. Extension of these models requires the use of electron distribution functions to describe the behavior of electrons in the undisturbed medium ahead of the discharge. These electrons, interacting with the electric field, determine the propagation of branches in the discharge and the way in which further branching occurs. The first phase in the extension of the referenced models , the calculation of simple electron distribution functions in an air/electric field medium, is discussed. Two techniques are investigated: (1) the solution of the Boltzmann equation in homogeneous, steady state environments, and (2) the use of Monte Carlo simulations. Distribution functions calculated from both techniques are illustrated. Advantages and disadvantages of each technique are discussed. Author

**N91-32727*#** Universidad Nacional de Cordoba (Argentina). Facultad de Matematica Astronomia y Fisica.
**CHARGE TRANSFER DURING INDIVIDUAL COLLISIONS IN ICE GROWING BY RIMING** **c33**
Eldo E. Avila and Giorgio M. Caranti *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 15 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09C

The charging of a target by riming in the wind was studied in the temperature range of (-10, -18 C). For each temperature, charge transfers of both signs are observed and, according to the environmental conditions, one of them prevails. The charge is more positive as the liquid water concentration is increased at any particular temperature. It is found that even at the low impact velocities used (5 m/s) there is abundant evidence of fragmentation following the collision. Author

**N91-32728*#** Golka (Robert K., Jr.) Associates, Brockton, MA.
**HOW TO CREATE BALL LIGHTNING**
Robert K. Golka, Jr. *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 2 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

Procedures are given on how to produce ball lightning. Necessary equipment includes a transformer of 150,000 watts capable of providing approximately 10,000 amperes at 15 volts, 60 cycles; thick one inch cables of stranded wire leading into a 3 by 4 by 1 foot plastic tank; a quarter inch thick 4 by 6 inch aluminum plate to be used as one of the discharge electrodes; and another electrode of heavy copper wire with the insulation stripped back 6 inches. Author

**N91-32729*#** Academy of Sciences (USSR), Moscow. Branch of All-Union Electrotechnical Inst.
**EXPERIMENTAL MODELLING OF LIGHTNING INTERACTION PHENOMENA WITH A FREE POTENTIAL CONDUCTING OBJECTS**
E. N. Chernov, A. V. Lupeiko, and N. I. Petrov *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 6 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

Laboratory experiments were conducted to investigate the physical processes of the development of air discharge and its interaction with free potential conducting objects. The space-time development of lightning in gaps was recorded by a motion picture camera and an optoelectronic transducer. The electric field at different points in the gap was measured using a Pockels device both in the leader stage and in the stage of the return stroke. Experimental results of the streamer zone length measurements in the gaps with lengths up to 65 meters are presented. The physical processes occurring during the interaction of positive and negative long sparks with isolated objects were investigated. The striking probability of isolated conducting spheres with different diameters and the dependence of the strike on the location of the gap are investigated. Author

**N91-32730*#** Harris Corp., Palm Bay, FL. Electronic Systems Div.
**DIFFUSE DISPERSIVE DELAY AND THE TIME CONVOLUTION/ATTENUATION OF TRANSIENTS** **c33**
Burt J. Bittner *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 5 p (For primary

document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

Test data and analytic evaluations are presented to show that relatively poor 100 KHz shielding of 12 Db can effectively provide an electromagnetic pulse transient reduction of 100 Db. More importantly, several techniques are shown for lightning surge attenuation as an alternative to crowbar, spark gap, or power zener type clipping which simply reflects the surge. A time delay test method is shown which allows CW testing, along with a convolution program to define transient shielding effectivity where the Fourier phase characteristics of the transient are known or can be broadly estimated. Author

**N91-32731*#** Lightning Eliminators Co., Inc., Boulder, CO.
**ADVANCES IN LIGHTNING PROTECTION THAT SATISFIES CONTEMPORARY STANDARDS** **c31**
Roy B. Carpenter, Jr. *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 8 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 13B

Described here are the LEC, Inc. Spline Ball Ionizer (trademark) (SBI) and the Spline Ball Terminal (trademark) (SBT) families and how their use in a conventional lightning protection system can achieve strike prevention in a conventional setting. A properly completed standards based system which is composed of the SBI and SBT in a hybrid system will provide two modes of lightning protection: (1) a stroke prevention mode that reduces the risk of a strike to the protected facility in proportion to the size of that facility and the size and number of SBI/SBT's used; and (2) a Stroke Collector-Diverter System that is far superior to any system now in use because it collects strokes entering the protected area from any direction and angle. Author

**N91-32732*#** Electromer Corp., Belmont, CA.
**CIRCUIT PROTECTION DEVICES FOR TRANSIENT SUPPRESSION** **c31**
Richard Childers *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 13B

The Electromer Corporation has developed a series of transient voltage suppression components based on a patented, specially formulated PolyClamp (trademark) material. PolyClamp components are a new class of transient voltage surge suppressors that extend the range of protection offered by transients protectors. The PolyClamp transient surge suppressors provide low capacitance, high energy capability, and packaging flexibility. A wide variety of applications can be protected. A tube and ferrule configuration was designed to be used with MIL/Aerospace style connectors and is designed to meet the applicable environmental, mechanical, and electrical requirements as defined by the United States and European defence standards performance requirements. Here, PolyClamp is compared with current transient surge suppressors. Typical performance and design are discussed. Author

**N91-32733*#** Electro Magnetic Applications, Inc., Lakewood, CO.
**EVALUATING LIGHTNING HAZARDS TO BUILDING ENVIRONMENTS USING EXPLICIT NUMERICAL SOLUTIONS OF MAXWELL'S EQUATIONS** **c31**
Richard S. Collier, Paul M. McKenna, and Rodney A. Perala *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
(Contract DAAA21-89-C-0176)
Avail: NTIS HC/MF A20 CSCL 13B

The objective here is to describe the lightning hazards to buildings and their internal environments using advanced formulations of Maxwell's Equations. The method described is the Three Dimensional Finite Difference Time Domain Solution. It can be used to solve for the lightning interaction with such structures in three dimensions with the inclusion of a considerable amount of detail. Special techniques were developed for including wire, plumbing, and rebar into the model. Some buildings have provisions for lightning protection in the form of air terminals connected to a ground counterpoise system. It is shown that fields and currents within these structures can be significantly high during a lightning strike. Time lapse video presentations were made showing the electric and magnetic field distributions on selected cross sections of the buildings during a simulated lightning strike. Author

**N91-32734*#** Florida Univ., Gainesville. Dept. of Electrical Engineering.
**VOLTAGES INDUCED ON A POWER DISTRIBUTION LINE BY OVERHEAD CLOUD LIGHTNING** **c33**
Ziad Yacoub, Marcos Rubinstein, Martin A. Uman, Ewen M. Thomson, and Pedro J. Medelius *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09C

Voltages induced by overhead cloud lightning on a 448 m open circuited power distribution line and the corresponding north-south component of the lightning magnetic field were simultaneously measured at the NASA Kennedy Space Center during the summer of 1986. The incident electric field was calculated from the measured magnetic field. The electric field was then used as an input to the computer program, EMPLIN, that calculated the voltages at the two ends of the power line. EMPLIN models the frequency domain field/power coupling theory found, for example, in Ianoz et al. The direction of the source, which is also one of the inputs to EMPLIN, was crudely determined from a three station time delay technique. The authors found reasonably good agreement between calculated and measured waveforms. Author

**N91-32735*#** Communications and Weather Research Foundation, Jacksonville, FL.
**GUIDELINES FOR A PROPOSED LIGHTNING PROTECTION POLICY OF A GOLF ASSOCIATION OR TOURNAMENT SPONSOR** **c31**
Charles C. Hillyer *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 7 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 13B

Because lightning causes many deaths and injuries each year on golf courses, guidelines are given for measures to be taken during golf events. Recommendations are given relative to warning systems, shelters, suspension of play, and the distribution of written policy statements. Author

**N91-32736*#** Florida Univ., Gainesville. Dept. of Electrical Engineering.
**INFLUENCE OF CHANNEL BASE CURRENT AND VARYING RETURN STROKE SPEED ON THE CALCULATED FIELDS OF THREE IMPORTANT RETURN STROKE MODELS**
Rajeev Thottappillil, Martin A. Uman, and Gerhard Diendorfer (Technische Hochschule, Vienna, Austria ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 9 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 04B

Compared here are the calculated fields of the Traveling Current Source (TCS), Modified Transmission Line (MTL), and the Diendorfer-Uman (DU) models with a channel base current assumed in Nucci et al. on the one hand and with the channel base current assumed in Diendorfer and Uman on the other hand. The characteristics of the field wave shapes are shown to be very sensitive to the channel base current, especially the field zero crossing at 100 km for the TCS and DU models, and the magnetic hump after the initial peak at close range for the TCS models. Also, the DU model is theoretically extended to include

any arbitrarily varying return stroke speed with height. A brief discussion is presented on the effects of an exponentially decreasing speed with height on the calculated fields for the TCS, MTL, and DU models. Author

**N91-32737*#** Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH. Pulse Power Group.
**HIGH CURRENT PULSE TESTING FOR GROUND ROD INTEGRITY** **c33**
Lawrence C. Walko *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
Avail: NTIS HC/MF A20 CSCL 09A

A test technique was developed to assess various grounding system concepts used for mobile facilities. The test technique involves applying a high current pulse to the grounding system with the proper waveshape and magnitude to simulate a lightning return stroke. Of concern were the step voltages present along the ground near the point of lightning strike. Step voltage is equated to how fast the current pulse is dissipated by the grounding system. The applied current pulse was produced by a high current capacitor bank with a total energy content of 80 kilojoules. A series of pulse tests were performed on two types of mobile facility grounding systems. One system consisted of an array of four 10 foot copper clad steel ground rods connected by 1/0 gauge wire. The other system was an array of 10 inch long tapered ground rods, strung on stainless steel cable. The focus here is on the pulse test technique used and its relevance to actual lightning strike conditions. Author

**N91-32738#** National Severe Storms Forecast Center, Kansas City, MO.
**SEVERE THUNDERSTORM CASES OF JULY 1989 THRU JUNE 1990**
J. E. Hales and H. G. Crowther Apr. 1991 132 p
(PB91-201202; NOAA-TM-NWS-NSSFC-29) Avail: NTIS HC/MF A07 CSCL 04B

Severe thunderstorm occurrences are relatively infrequent in much of the United States. As a result a forecaster only occasionally has an opportunity to forecast their development. This proves to be a problem as certainly one of the more important factors in forecasting severe thunderstorms is the level of experience of the forecaster. Realizing the importance that experience plays and difficulty involved for a meteorologist to study past cases, a summary was compiled of all the organized severe thunderstorm episodes for the period from July 1988 to June 1989. Included in each case were the times and locations of the severe weather reported along with specifics of the more noteworthy events. A composite of these parameters most frequently found to be associated with severe thunderstorms was included. Each case has a surface and 500 mb analysis along with an IR satellite photo. The objective was to give and overview to a forecaster as to what ingredients went into severe development with a more detailed analysis being left up to the individual. Author

**N91-32739#** National Geophysical Data Center, Boulder, CO.
**STUDY ON OBSERVATIONAL SYSTEMS: A REVIEW OF METEOROLOGICAL AND OCEANOGRAPHIC EDUCATION IN OBSERVATIONAL TECHNIQUES AND THE RELATIONSHIP TO NATIONAL FACILITIES AND NEEDS**
R. Serafin, B. Heikes, D. Sargeant, W. Smith, and E. Takle Jan. 1991 55 p Prepared in cooperation with American Meteorological Society, Boston, MA Sponsored by NSF
(PB91-198168) Avail: NTIS HC/MF A04 CSCL 04B

The results of a survey of meteorological and oceanographic education, in observational technology are presented. The study consisted of a survey of curricula, laboratories and equipment, and educational materials at 48 universities and interviews with 32 members of the research community from universities, government labs, and the private sector. It was found that there is a widening gap between the sophistication and complexity of state of the art measurement technology and the ability of universities to offer relevant and adequate curricula. Universities are finding it increasingly difficult to maintain even basic instructional programs in observational systems and associated lab facilities. Recommendations for dealing with the situation are presented. Author

**N91-32740#** North Carolina Univ., Chapel Hill. Dept. of Geography.
**PRECIPITATION REGIME CHANGES ASSOCIATED WITH CLIMATIC CHANGES**
P. J. Robinson and S. J. Walsh Jan. 1991 153 p Sponsored by Geological Survey, Reston, VA
(Grant DI-14-08-0001-G-1656)
(PB91-206656; USGS/G-1656) Avail: NTIS HC/MF A08 CSCL 04B

The relationship between precipitation events and atmospheric circulation in the southeastern U.S. is investigated to provide information potentially useful in assessing the impact of climate change on water resources. There are about 130 precipitation events annually, evenly divided by season. Most events are less than 1 hour long and give less than one tenth inch of rain. The Appalachian mountains have longer storms, and south Florida shorter, sharper ones, than the regional average. When continental scale atmospheric circulation patterns create airflows predominantly from the southwest, areas east of the mountains have long, heavy, and variable events, while western events have the opposite character. Predominantly westerly flow gives a reverse trend. A Geographic Information System was used to develop and test methods for display and analysis of the spatial distribution of event precipitation. Author

**N91-32741#** Oak Ridge National Lab., TN.
**HISTORICAL SUNSHINE AND CLOUD DATA IN THE UNITED STATES**
D. P. Kaiser, P. M. Steurer, and T. R. Karl (National Climatic Data Center, Asheville, NC.) May 1991 137 p
(Contract DE-AC05-84OR-21400)
(DE91-016825; ORNL/CDIAC-43; ESDP-3689) Avail: NTIS HC/MF A07

This document describes a data base containing United States monthly and annual historical time series of sunshine duration (observed hours of sunshine, maximum possible hours of sunshine, and percentage of possible sunshine) and mean sunrise to sunset fractional cloud amount. These data were assembled by the National Climatic Data Center (Asheville, NC) and the U.S. Department of Energy in response to the need for regional historical sunshine and cloud amount data sets for use in the study of climate change. A total of 240 sunshine time series (longest period of record, 1891-1987) and 197 cloud amount time series (longest period of record, 1871-1987) have been assembled. The high correlation between these two data sets has allowed for an independent method of quality assurance and the development of a procedure for producing estimates when data are missing in either of the two time series. These new data sets contain the most complete and highest quality cloud and sunshine time series available to the research community and should prove invaluable in the assessment of climate change in the United States over the last century. These data are available free of charge as a numeric data package (NDP) from the Carbon Dioxide Information Analysis Center. The NDP consists of this document and a magnetic tape containing machine-readable data files, a descriptive file, and computer access codes. This document defines limitations and restrictions of the data, describes the format and contents of the magnetic tape, and provides a reprint of a pertinent journal article. DOE

**N91-32742#** Massachusetts Univ., Amherst.
**CLIMATE RESEARCH SYSTEM**
R. S. Bradely, H. F. Diaz, P. M. Kelly, and P. D. Jones 1991 42 p
(Contract DE-FG02-89ER-69017)
(DE91-016903; DOE/ER-69017/3) Avail: NTIS HC/MF A03

This report primarily summarizes the results of work

accomplished in year 3 of the grant; previous reports have documented earlier progress. At the outset of this project, we set out to accomplish the following goals: (1) to improve and extend the DOE long term surface climate data set in order to provide more accurate estimates of regional climate variations; (2) to analyse in detail critical regions of the earth, which because of their locations and special climate characteristics provide a natural laboratory where the impacts of global climate change are likely to be felt first and/or most severely; (3) assess temporal and spatial coherence of hydrologic variability, particularly in those regions identified as especially vulnerable to greenhouse gas-induced climatic change; and (4) undertake more detailed comparisons of general circulation model simulations of future climate with increased greenhouse gas concentrations, in relation to regional climatic patterns over the oceans and continents. Over the past three years, we have addressed each of these topics. In this paper, we provide a summary of research, organized thematically, to highlight the more important findings. DOE

**N91-32743#** Lawrence Livermore National Lab., CA.
**A THREE-DIMENSIONAL NUMERICAL SIMULATIONS OF MESOSCALE FLOW OVER KSC/CC AREA OF FLORIDA**
S. Zhong, E. S. Takle (Iowa State Univ. of Science and Technology, Ames.), and J. M. Leone, Jr. Nov. 1989 5 p Presented at the 4th Conference on Mesoscale Processes American Meterological Society (AMS), Boulder, CO, 25-29 Jun. 1989
(Contract W-7405-eng-48)
(DE91-017445; UCRL-102260; CONF-8906411-1) Avail: NTIS HC/MF A01

The Kennedy Space Center/Cape Canaveral (KSC/CC) environment consists of complex patterns of land and water that creates differential surface heating on scales of few hundred meters to those of the classical sea breeze. We here report an investigation of the extent to which the resulting mean flow field differs from that of the conventional sea-breeze circulation. The Kennedy Space Center Atmospheric Boundary Layer Experiment (KABLE) was an observational program that included measurements from acoustic sounders, a high-resolution rawinsonde, and a tower network taken from November 1988 through October 1989. KABLE data document the 3-D structure of the atmospheric boundary layer, including small-scale features that add complexity to the sea-breeze circulation. We have numerically simulated the flow field observed on 13 November 1989 and compared the results with numerical experiments designed to isolate the effects of the small-scale flows and examine their influence on the classical sea breeze. DOE

**N91-32744#** Argonne National Lab., IL.
**PARALLEL SCALABILITY OF THE SPECTRAL TRANSFORM METHOD**
I. Foster, W. Gropp, and R. Stevens 1991 6 p Presented at the 5th Society for Industrial and Applied Mathematics (SIAM) Conference, Houston, TX, 22-29 Mar. 1991
(Contract W-31-109-eng-38)
(DE91-017991; ANL/CP-73809; CONF-910326-8) Avail: NTIS HC/MF A02

General circulation models (GCMs) are rarely run at resolutions finer than 100 km when used for weather modeling and 400 km when used for climate modeling. Yet simulation of weather and climate on a regional scale requires resolution measured in the tens of kilometers. This will require substantially greater computational resources than are available today on even the fastest vector computers. The spectral transform method, despite well-known deficiencies, is the most widely used in current models because of its computational efficiency. Hence, it is important to understand the suitability of this method for parallel implementation. Here we consider the efficiencies of two different decompositions of the data across parallel processors. We combine both asymptotic analysis (dropping terms only when they are negligible for expected problem sizes) and empirical studies (for calibration of costs) of the shallow-water equations to get a realistic complexity estimate for parallel implementations of GCMs. Kauranne has provided a quick survey of some current thinking about parallelism in weather models and a high level discussion of achievable parallelism. DOE

# 48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

**N91-32745#** Institute of Oceanographic Sciences, Wormley (England).
**GEOPLOT: USER GUIDE AND PROGRAMMER'S GUIDE**
S. D. Buxton and T. P. LeBas 1990 89 p
(IOS-279; ETN-91-99887) Avail: NTIS HC/MF A05; Institute of Oceanographic Sciences, Deacon Lab., Wormley, Godalming, Surrey GU8 5UB, England, HC 23 sterling pounds

The program GEOPLOT can plot ships' tracks and their associated geophysical data in several ways. A complete guide for both users and programmers is given. Full instructions and example plots for the novice users are provided. For the programmer it includes a structural description of the program and all its subroutines, together with details of the library subroutines used. ESA

**N91-32746#** JAYCOR, Vienna, VA.
**GULF OF MEXICO CIRCULATION MODELING STUDY: ANNUAL PROGRESS REPORT: YEARS 3 AND 4 Final Report, 1982-1990**
A. J. Wallcraft Mar. 1991 226 p Sponsored in part by Minerals Management Service, Metairie, LA
(Contract DI-14-12-0001-30073)
(PB91-210666; OCS/MMS-90/0008) Avail: NTIS HC/MF A11 CSCL 08C

The final report of a four-year numerical ocean circulation modeling program for the Gulf of Mexico is presented. The aim of the program was to progressively update an existing model of the Gulf of Mexico to provide the most realistic long-term simulation possible of Gulf circulation. The NOARL/JAYCOR multilayer hydrodynamic and thermodynamic primitive equation circulation models of the Gulf of Mexico on a 0.2 and 0.1 deg grid were used in the program. They were forced by constant inflow through the Yucatan Straits, compensated by outflow through the Florida Straits, and by wind stresses from the Navy Corrected Geostrophic Wind data set for the Gulf of Mexico. The most realistic simulation produced by the program was a blending of one- and two-layer experiments, augmented by a perturbation analysis to extract surface currents from the vertically averaged ocean model velocities. Actual wind stresses from 1967 to 1982 were used to force the simulation, but the resulting currents are intended to be representative of Gulf circulation rather than a hindcast of the actual state of the Gulf over this time period. Author

**N91-32747#** National Geophysical Data Center, Boulder, CO.
**UJNR TSUNAMI WORKSHOP PROCEEDINGS**
A. M. Brennan and J. F. Lander Mar. 1991 252 p Second Workshop held in Honolulu, HI, 5-6 Nov. 1990
(Grant NSF BCS-89-08688)
(PB91-193656; KGRD-24) Avail: NTIS HC/MF A12 CSCL 08C

Papers from the workshop are presented. The major topics covered include: (1) predictions and observations of tsunami behavior in coastal waters and on land; (2) applications of numerical modeling to improve travel time predictions, source region definition, inundation, and run-up prediction; and (3) protective measures in Japan and the U.S. with regard to the use of numerical models and the design tsunami concepts. GRA

# 51 LIFE SCIENCES (GENERAL)

**N91-32748#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Biophysik.
**PHOTOBIOLOGICAL INVESTIGATIONS ON SPORES OF STREPTOMYCES GRISEUS Ph.D. Thesis - Giessen Univ.**
Birgit Keller Mar. 1991 111 p In GERMAN; ENGLISH summary Report will also be announced as translation ESA-TT-1269
(DLR-FB-91-14; ISSN-0939-2963; ETN-91-90044; ESA-TT-1269) Avail: NTIS HC/MF A06; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 36.50 DM

On spores of Streptomyces griseus the UV action spectra of inactivation were compared between wet and dry state. In vacuum, the spores are more resistant to UV by a factor of two than under wet conditions. Their photoreactivity is reduced. The cross sections for induction of DNA double strand breaks and for inactivation show similar dependence on wavelength. ESA

**N91-32749#** California Univ., Berkeley. Lawrence Berkeley Lab.
**BIOPHYSICAL AND GENETIC ASPECTS OF LIGHT-POTENTIATED GRAVITROPIC CURVATURE IN THE MAIZE PRIMARY ROOT Ph.D. Thesis**
D. M. Fantin Apr. 1991 190 p
(Contract DE-AC03-76SF-00098)
(DE91-016255; LBL-30682) Avail: NTIS HC/MF A09

This thesis explores issues related to light-induced gravitotropic curvature in maize primary roots, such as the root cap as the potential photosensor, entrainment by light of curvature in the gravistimulated root, and the possibility of genetic control of bending response variation. Central to this thesis is a mathematical model, emphasizing physical forces and molecular flows, linking the stages of light-stimulated gravitropic curvature. The model assumes a growth inhibitor is produced in the root cap, transported by diffusion to the extension zone, and transported by convection around the extension zone, where it retards growth at a rate proportional to its concentration. Model predictions were compared to experimental data to evaluate these assumptions. The root cap is shown to be the photosensor, and genetic crosses show that more than two genes must control the bending response. DOE

**N91-32750#** Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM. Inhalation Toxicology Research Inst.
**BIOPHYSICAL AND BIOMATHEMATICAL ADVENTURES IN RADIOBIOLOGY**
B. R. Scott 1991 30 p Presented at the 5th Annual Southern Univ. Coll. of Science Symposium on Versatility and Wonders Or Physics, Baton Rouge, LA, Mar. 1991 Submitted for publication
(Contract DE-AC04-76EV-01013)
(DE91-017484; CONF-9103198-1) Avail: NTIS HC/MF A03

Highlights of my biophysical and biomathematical adventures in radiobiology is presented. Early adventures involved developing state-vector models for specific harmful effects (cell killing, life shortening) of exposure to radiation. More recent adventures led to developing hazard-function models for predicting biological effects (e.g., cell killing, mutations, tumor induction) of combined exposure to different toxicants. Hazard-function models were also developed for predicting harm to man from exposure to large radiation doses. Major conclusions derived from the modeling adventures are as follows: (1) synergistic effects of different genotoxic agents should not occur at low doses; (2) for exposure of the lung or bone marrow to large doses of photon radiation, low rates of exposure should be better tolerated than high rates; and (3) for some types of radiation (e.g., alpha particles and fission neutrons), moderate doses delivered at a low rate may be more harmful than the same dose given at a high rate. DOE

**N91-32751#** Arizona State Univ., Tempe.
**PARTICULATE MODELS OF PHOTOSYNTHESIS**
G. R. Seely Jun. 1991 23 p
(Contract DE-FG02-86ER-13620)
(DE91-016842; DOE/ER-13620/4) Avail: NTIS HC/MF A03

A chlorophyll model system for photochemical energy conversion has been developed. When irradiated with red light, reducing equivalents are transferred from hydrazobenzene in the hydrocarbon particles to 5,5'-dithiobis (2-nitrobenzoate) in the aqueous phase. The primary photochemical step is transfer of an electron from singlet excited chlorophyll to a primary oxidant ligated to it, or to another chlorophyll to a primary oxidant ligated to it, or to another chlorophyll molecule, depending on the composition of the system. Evidence for the mode of operation derives from analysis of kinetics and quantum yields of reaction, and of fluorescence spectra, quantum yields, and lifetimes. It was found that chlorophyll associates strongly with micelles of N-dodecyl pyridinium iodide in toluene, its hydrate is maintained in a dispersed state by dodecylpyridinium alkanoates, and that it reacts with 2,2'-dithiobis (5-nitropyridine) by photoaddition of a nitro pyridylthiyl group. Procedures for correcting fluorescence spectra and quantum yields in highly scattering media were worked out and applied to the characterization of the model system. DOE

**N91-32752#** Argonne National Lab., IL.
**THE ROLE OF SPIN CHEMISTRY IN THE PRIMARY EVENTS OF PHOTOSYNTHESIS**
G. Kothe, S. Weber, S. S. Snyder, Jau Tang, M. C. Thurnauer, A. L. Morris, R. R. Rustandi, and Zhiyu Wang (Chicago Univ., IL.) 1991 15 p Presented at the OJI International Conference on Spin Chemistry, Tomakomai (Japan), 15-18 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-017301; ANL/CP-73656; CONF-9107163-1) Avail: NTIS HC/MF A03

We have developed theoretical treatments and have performed various transient experiments such as RYDMR (reaction yield detected magnetic resonance) and FT-CIDEP (Fourier transform-chemically induced dynamic electron spin polarization) to understand the role that spin chemistry may play in photosynthesis. In this paper, we extend our vector model to include the Redfield density matrix formalism in order to accommodate explicitly the processes of sequential electron transfer, relaxation and coherence. The formal calculations will be illustrated using radical pairs occurring in photosynthetic reaction centers, including oscillations attributable to coherent spin dynamics. Quantum beats have been observed as predicted for radical pairs in fully deuterated algae using ultrahigh time resolution continuous wave electron paramagnetic resonance (EPR). Time domain simulations can provide information on T(sub 1), T(sub 2), and the lifetime of the radical pair. DOE

# 52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

**N91-32753** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Visuology Group.
**INTRODUCTION TO MULTIRESOLUTION MORPHOLOGY Final Report**
A. Toet 6 Mar. 1991 32 p
(Contract A87/D/149)
(IZF-1991-A-10; TD-91-0038; ETN-91-99990) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Kampweg, Netherlands

Some new multiresolution image representations are presented in which iterative morphological filters of many scales but identical shape serve as basis functions. The representations differ from established techniques in that the primitives have a well defined location and size. Structural pattern decompositions are obtained by subtracting successive layers in the multiresolution representations. The resulting image descriptions provide a useful basis for multiresolution shape analysis and synthesis and are well suited for parallel and VLSI (Very Large Scale Integration)

implementation. Examples are provided which show that multiresolution morphology can also be used to fuse images originating from multiple sensors and/or different sensing modalities. An attempt was made to visualize the morphological operations as much as possible. ESA

**N91-32754#** School of Aerospace Medicine, Brooks AFB, TX.
**PUBLICATIONS AND PRESENTATIONS OF THE OPTHALMOLOGY BRANCH, USAF SCHOOL OF AEROSPACE MEDICINE, 1981-1990 Interim Report, Jan. 1981 - Dec. 1990**
Thomas J. Tredici and Bertha B. Secord Dec. 1990 56 p
(AF Proj. 7755)
(AD-A239458; USAFSAM-SR-90-6) Avail: NTIS HC/MF A04
CSCL 06/5

Aerospace ophthalmology combines the practice of Clinical Ophthalmology and Aerospace Medicine in attempting to solve the visual and ophthalmological problems of the aviator and astronaut. The Ophthalmology Branch of the USAF School of Aerospace Medicine has exclusively performed this task for nearly 75 years. The visual problems and solutions proposed are documented in the publications and invited presentations of Ophthalmology Branch personnel, listed in chronological order for the years 1981 through 1990. They deal primarily with applied visual and clinical topics, such as visual standards for flying, the use of contact lenses in aviation, visual illusions and aircraft accidents, air-to-air target acquisition, management of glaucoma in flying personnel, etc. GRA

**N91-32755#** National Inst. for Occupational Safety and Health, Cincinnati, OH.
**SCIENTIFIC WORKSHOP ON THE HEALTH EFFECTS OF ELECTROMAGNETIC RADIATION ON WORKERS: BIBLIOGRAPHY**
30 Jan. 1991 280 p Presented at a Workshop in Cincinnati, OH, 30-31 Jan. 1991
(PB91-173351) Avail: NTIS HC/MF A13 CSCL 06R

The bibliography contained references generated from a computer literature search of various data bases. The references were published prior to mid 1990. The terms included in the search were: power transmission, extremely low frequency, very low frequency, 50 Hz, 60 Hz, and magnetic and electromagnetic fields. Each citation contained the usual pertinent material plus the data base abstract of the reference, when available. The bibliography was divided into the following sections: in vitro studies; in vivo studies (including gross effects observations; reproductive effects; cardiovascular, serum, endocrine, organs; immune systems, tumors, leukemia, growth, enzymes; neurological, pineal, behavioral; chicks, eggs, embryos; birds, nesting, population density, collisions; Drosophilia melanogaster; and botanical effects); epidemiologic studies; measurement and control; and transmission lines.
Author

**N91-32756#** Pacific Northwest Lab., Richland, WA.
**INTERACTION OF EXTREMELY-LOW-FREQUENCY ELECTROMAGNETIC FIELDS WITH HUMANS**
T. S. Tenforde Jul. 1991 8 p Presented at the 9th International Congress of Radiation Research (ICRR) Conference, Toronto, Ontario, 7-12 Jul. 1991
(Contract DE-AC06-76RL-01830)
(DE91-015779; PNL-SA-19016; CONF-9107136-4) Avail: NTIS HC/MF A02

At a macroscopic level, the effects of extremely low frequency (ELF) electromagnetic fields on humans are well understood based on fundamental physical principles, but far less is known about the nature of the interactions at a cellular or molecular level. Current evidence suggests the effects of ELF on cellular biochemistry are due to interactions with the cell membrane. Elucidation of the mechanism that underlies this transmembrane signaling is critical for a molecular-level understanding of ELF field effects. Further research is also required to clarify a possible link between ELF exposure and increased cancer risk, since estimated ELF exposure in occupational or residential settings is much lower that the levels used in laboratory studies. There is a clear need for additional epidemiological research in which qualitative dosimetry is used to characterize ELF exposure and careful attention is given to possible effects of confounding variables.
DOE

**N91-32757#** Argonne National Lab., IL. Environmental Assessment and Information Sciences Div.
**ASSESSING THE RISK OF CHRONIC LUNG INJURY ATTRIBUTABLE TO LONG-TERM OZONE EXPOSURE**
R. G. Whitfield, T. S. Wallsten, and R. L. Winkler (Duke Univ., Durham, NC.) Jul. 1991 108 p
(Contract W-31-109-eng-38)
(DE91-016814; ANL/EAIS-2) Avail: NTIS HC/MF A06

The research described here is part of a larger risk assessment project sponsored by the U.S. Environmental Protection Agency. The purpose of this research is to characterize scientific judgment regarding the risk of chronic lung injury to children aged 8 through 16 and adult outdoor workers due to long term ozone exposure in areas with patterns of exposure similar to those found in southern California and the Northeast. The qualitative and quantitative judgments resulting from the work will not be used in the ongoing review of the ozone primary ambient air quality standard. They will instead be used to inform policymakers and the public about the possible health implications of long term exposure to ozone. Our measure of injury is the incidence of mild or moderate lesions in the centriacinar region of the lung. The probabilities over population response rates were elicited from six health experts actively researching ozone-induced lung injury. We describe our approach and present the results in the form of judgmental probability distributions and associated qualitative comments over the population response rate for formation of lesions induced by exposure to ozone. DOE

**N91-32758#** Lawrence Livermore National Lab., CA.
**THE EFFECT OF SHOWER/BATH FREQUENCY ON THE HEALTH AND OPERATIONAL EFFECTIVENESS OF SOLDIERS IN A FIELD SETTING**
L. C. Hall and J. I. Daniels 1 Nov. 1990 12 p
(Contract W-7405-eng-48)
(DE91-017545; UCRL-CR-105166-1) Avail: NTIS HC/MF A03

Dermal disease is a significant cause of morbidity among soldiers in a combat setting. For example, among American combat troops in Vietnam, disability from skin disease was one of the single most important medical causes of man-days lost from combat. Currently, the U.S. Army makes shower or bath facilities available to soldiers in the field on a weekly basis. U.S. Army after-action reports and anecdotal descriptions from the field indicate that this may not be an optimal regimen for the maintenance of personal hygiene, especially with respect to diseases of the skin. Determination of the optimal frequency of showering of bathing for soldiers in a combat setting is complicated by the fact that soldiers in the U.S. Army may be involved in field exercise or combat in many different areas of the world with a variety of climatic conditions. Although certain aspects of the role of environmental factors in the incidence and severity of dermal disease have been documented, the role of hygiene in the potential mitigation of these effects has not been evaluated. The present project entails a comprehensive review and analysis of available literature in order to determine the health impact of shower/bath frequency for soldiers in a combat setting. An integral component of this work is an evaluation of the impact of climate, and microclimate produced by clothing, on the type, frequency, and severity of skin disease. There is a relatively large body of information concerning the effectiveness of antimicrobial soaps in minimizing the incidence and severity of dermal disease. This data will be evaluated to determine whether use of these soaps, or an increase in the use of cleansing agents in general, will result in a decrease in the severity and incidence of diseases of the skin for soldiers in the field. DOE

**N91-32759#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

**MOTION SICKNESS: SIGNIFICANCE IN AEROSPACE OPERATIONS AND PROPHYLAXIS**

Sep. 1991 201 p In ENGLISH and FRENCH Lecture series held in Toronto, Ontario, 7-8 Oct. 1991, in Athens, Greece, 24-25 Oct. 1991, and in De Bilt, Netherlands, 28-29 Oct. 1991

(AGARD-LS-175; ISBN-92-835-0634-0) Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

In aerospace activities, motion sickness, specifically air sickness, continues to be a problem during flying training and in regular operations for aircrew and passengers. Simulator sickness can degrade the effectiveness of simulator training and space sickness reduces the efficiency of astronauts. Sea sickness is also of aeromedical concern in so far as it affects aircrew operating from ships and the survivability of ditched sailors. The presentation is proposed as an aid to flight surgeons in the performance of their primary care duties. For individual titles, see N91-32760 through N91-32769.

**N91-32760#** Defence and Civil Inst. of Environmental Medicine, North York (Ontario).

**SIGNS AND SYMPTOMS OF MOTION SICKNESS AND ITS BASIC NATURE**

K. E. Money (Canadian Space Agency, Ottawa, Ontario ) *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 4 p (For primary document see N91-32759 24-52)

Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The cardinal signs and symptoms of motion sickness are malaise, pallor, (and/or flushing), cold sweating, abdominal discomfort, changes in gastric motility, and changes in levels of circulating hormones. Cardiovascular, respiratory, and other signs have also been reported, as have a variety of other sensations, feelings, and performance changes. It is reasonable to think that motion sickness is basically the activation, by motion, of a poison response mechanism. Author

**N91-32761#** Naval Aerospace Medical Inst., Pensacola, FL.

**MOTION SICKNESS AND ITS RELATION TO SOME FORMS OF SPATIAL ORIENTATION: MECHANISMS AND THEORY**

Fred E. Guedry (University of West Florida, Pensacola.) *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 30 p (For primary document see N91-32759 24-52)

Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The mechanisms of motion sickness fall under three component topics, which separately involve distinctive subject matters and together challenge the entire scope of neuroscience disciplines. The components are as follows: (1) the process involved in the sensorimotor and perceptual motor adjustments to the sustained experience of unusual motion; (2) the neurochemical link whereby the neurochemical processes and byproducts of sensorimotor adjustment accumulate to a threshold level that when exceeded elicits the sickness syndrome; and (3) the sickness syndrome, which includes emesis and all of the autonomic and physiological accompaniments that degrade performance. These mechanisms are studied in detail. Author

**N91-32762#** Southampton Univ. (England). Human Factors Research Unit.

**PHYSICAL CHARACTERISTICS OF STIMULI PROVOKING MOTION SICKNESS**

Michael J. Griffin *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 32 p (For primary document see N91-32759 24-52)

Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The physical characteristics of motion stimuli responsible for motion sickness are reviewed in two parts. The provocative stimuli are categorized and their nauseogenic properties discussed qualitatively in terms of the sensory conflict theory of motion sickness. Quantitative data available from experimental studies with specific types of motion is then summarized. The motions of the body considered include translational oscillation, swing motions, rotation about a vertical axis, rotation about an off-vertical axis, rotational oscillation, and cross coupled (i.e., Coriolis) stimulation. Conditions producing visually induced motion sickness are also summarized. Author

**N91-32763#** Naval Aerospace Medical Inst., Pensacola, FL.

**FACTORS INFLUENCING SUSCEPTIBILITY: INDIVIDUAL DIFFERENCES AND HUMAN FACTORS**

Fred E. Guedry (University of West Florida, Pensacola.) *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 18 p (For primary document see N91-32759 24-52)

Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

From a conceptual viewpoint, individual differences in susceptibility to motion sickness are determined by differences in the following: initial reactivity (receptivity), ability to adapt to the motion, ability to retain the adaptation during abstinence periods, and ability to reinstate adaptive responses upon reexposure to motion. From a theoretical viewpoint, the adaptive adjustment involves alteration of the timing, magnitude, and direction of sensorimotor reactions so as to increase the efficiency of postural control in the motion environment. However, the threshold linking the sensorimotor adaptive process to the processes that set-off the signs and symptoms of motion sickness may also be an individual characteristic. A conceptual model is presented to organize the discussion of individual differences in motion sickness susceptibility. Factors that have been reported to influence incidence of motion sickness such as age, mental activity, anxiety and fear, perceptual style, physical fitness, active control of the inducing motion, concomitant visual stimulation, quality of the initial exposure to the motion environment, and conditioned motion sickness are discussed. Author

**N91-32764#** Defence and Civil Inst. of Environmental Medicine, North York (Ontario).

**SPACE SICKNESS**

K. E. Money (Canadian Space Agency, Ottawa, Ontario ) *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 5 p (For primary document see N91-32759 24-52)

Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Motion sickness in spaceflight occurred only rarely in the earliest space flights in small capsules, but in the larger Space Shuttle the incidence is fully 70 pct. Apparently, in larger spacecraft the requirement to make head movements and body movements in weightlessness, increases the likelihood of space sickness. Typically, after its appearance in the first day of a spaceflight, space sickness is made worse by head movements and by disorientation, and it is ameliorated by remaining motionless. Antimotion sickness drugs have been useful in dealing with space sickness and biofeedback techniques might be useful, but attempts to predict susceptibility (except by assessing susceptibility on previous spaceflights) have not been successful. Author

**N91-32765#** Defence and Civil Inst. of Environmental Medicine, North York (Ontario).

**SIMULATOR SICKNESS**

K. E. Money (Canadian Space Agency, Ottawa, Ontario ) *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 4 p (For primary document see N91-32759 24-52)

Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Sickness in a flight simulator can compromise training, and it can also give rise to effects that persist afterwards and create

hazards for the trainee. Generally, simulator sickness involves more visual disturbances, more dizziness, and more aftereffects than in other kinds of motion sickness, and less gastrointestinal disturbance (although a few instances of frank vomiting have been reported, both in the simulator and after leaving it). Simulator sickness can interfere with, and discourage participation in, simulator training. Its aftereffects could cause accidents, and to avoid these accidents, the trainees are often grounded for a while after flying the simulators. Different incidences of simulator sickness, most between 10 and 60 pct., were found in different simulators and depend partly on the criteria for the sickness and on how the simulator is used. Procedures for minimizing the problem were developed. Author

**N91-32766#** Southampton Univ. (England). Human Factors Research Unit.
**SEA SICKNESS**
Michael J. Griffin *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 20 p (For primary document see N91-32759 24-52)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A historical illustration of the prevalence of motion sickness at sea is followed by a review of experimental studies in which both ship motion and sickness were quantified. The motions responsible for sea sickness are identified and alternative methods of predicting sea sickness from measures of ship motion are defined. The influence of causal factors other than motion are also considered. Author

**N91-32767#** Institute of Aviation Medicine, Farnborough (England).
**PREVENTION AND TREATMENT OF MOTION SICKNESS: NON-PHARMACOLOGICAL THERAPY**
J. R. R. Stott *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 9 p (For primary document see N91-32759 24-52)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The concept that conflicting sensory patterns of motion constitute the stimulus that in susceptible subjects gives rise to motion sickness, allows rational measures to be taken aimed at minimizing sensory conflict and thereby reducing the incidence of symptoms. Such measures add to the effectiveness of prophylactic drugs and may alone be sufficient to prevent motion sickness. It is well known among sailors and astronauts that continued or repeated exposure to an initially nauseogenic motion stimulus leads to a state of increased resistance to its effect. This provides a spontaneous cure for some individuals and forms the basis of therapeutic programs to assist others. The strategies that individuals can adopt to minimize their exposure to nauseogenic stimuli are presented, as well as with adaptation and its application to the treatment of chronic airsickness in aircrew. Also considered are some of the nonpharmalogical measures that have been used in the treatment of motion sickness. Author

**N91-32768#** Amsterdam Univ. (Netherlands). University Hospital.
**ASSESSMENT OF DRUG EFFECTIVENESS**
W. J. Oosterveld *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 8 p (For primary document see N91-32759 24-52)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The inhibitory effect was studied of Touristil, a combination of Cinnarizine 40 mg and Domperidone 30 mg, on the labyrinth. Each of these two compounds exerts a vestibular inhibition separately, albeit through different mechanisms. The activity of Cinnarizine (C) is rather slow at the onset, and reaches a maximum after 2 to 3 hours, while the peak effect of Domperidone (D) comes about more rapidly. It emerged from this study that the two separate compounds C and D, once in combination in Touristil (C+D), has a synergistic effect on the vestibular system in the form of an inhibition. The maximum reduction of about 60 pct. obtained is altogether exceptional and clearly underlines the potency of the new combination. Also, it is shown that Touristil is most effective in those subjects who are not affected by C, the most potent of the two, when given exclusively. As there is an obvious relationship between the inhibitory action of a drug on the labyrinth and its value as a medication against motion sickness, it may be concluded that Touristil is a very potent preparation against motion sickness. Author

**N91-32769#** Institute of Aviation Medicine, Farnborough (England).
**MANAGEMENT OF ACUTE AND CHRONIC MOTION SICKNESS**
J. R. R. Stott *In* AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis Sep. 1991 7 p (For primary document see N91-32759 24-52)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

To the general physician, the problem of motion sickness typically is presented as a request for advice on how to avoid motion sickness when travelling, or during leisure activities such as gliding or sailing. More urgently, a doctor aboard ship in rough weather may be confronted with the need to treat individuals prostrated by repeated vomiting as a result of sea sickness. The military doctor may have to deal with the operational problem of air sickness in trainee aircrew, sea sickness in sailors, or motion sickness among troops transferred by air, in enclosed army personnel carriers, landing craft or tanks. Finally, because motion sickness may have financial implications by contributing to the failure rate in a costly training program, medical advice may be sought in order to minimize the economic problem of wastage in training. These and other factors are considered in the diagnosis and prophylactic treatment of motion sickness. Author

**N91-32770#** Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM. Inhalation Toxicology Research Inst.
**THE RELEVANCE OF ANIMAL BIOASSAYS TO ASSESS HUMAN HEALTH HAZARDS TO INORGANIC FIBROUS MATERIALS**
N. F. Johnson 1990 11 p Presented at the NATO Advanced Research Workshop, Albuquerque, NM, 22-25 Oct. 1990
(Contract DE-AC04-76EV-01013)
(DE91-017516; CONF-9010405-1) Avail: NTIS HC/MF A03

Animal inhalation experiments are relevant to assessing human health risks from inorganic fibers. Appropriately conducted inhalation experiments should be used to identify hazardous fibrous materials, because other animal bioassays can give false positive results. Injection and instillation bioassays can be used to screen and identify the most biologically active materials for subsequent inhalation experiments. DOE

**N91-32621*#** Wesley Hospital, Brisbane (Australia).
**THE QT INTERVAL IN LIGHTNING INJURY WITH IMPLICATIONS FOR THE CESSATION OF METABOLISM HYPOTHESIS**
Christopher J. Andrews, David M. Colquhoun, and Mat Darveniza (Queensland Univ., Brisbane, Australia ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 11 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 06R

**N91-32622*#** Wesley Hospital, Brisbane (Australia).
**FURTHER IDENTIFICATION AND TREATMENT MODALITIES IN TELEPHONE MEDIATED LIGHTNING STRIKE**
Christopher J. Andrews and Mat Darveniza (Queensland Univ., Brisbane, Australia ) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 8 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 06R

**N91-32623*#** Aerospace Corp., Los Angeles, CA.
**STEP VOLTAGE ANALYSIS FOR THE CATENOID LIGHTNING PROTECTION SYSTEM**
J. C. Chai, R. Briet, D. L. Barker, and H. E. Eley *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 9 p (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 06R

**N91-32777*#** Texas Univ. Health Science Center, San Antonio.
**HEALTH MAINTENANCE FACILITY: DENTAL EQUIPMENT REQUIREMENTS**
John Young, John Gosbee, and Roger Billica (Krug International, Houston, TX.) *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 1-4 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

**N91-32778*#** Texas Univ. Health Science Center, San Antonio.
**DENTAL EQUIPMENT TEST DURING ZERO-GRAVITY FLIGHT**
John Young, John Gosbee, and Roger Billica (Krug International, Houston, TX.) *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 5-19 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

**N91-32780*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**OPERATION AND PERFORMANCE OF THE CIBA-CORNING 512 COAGULATION MONITOR DURING PARABOLIC FLIGHT**
Robyn Gocke, Charles W. Lloyd, and Nancy K. Greenthaner (Krug Life Sciences, Inc., Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 41-58 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

**N91-32781*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**APPLICATION AND USE OF SPINAL IMMOBILIZATION DEVICES IN ZERO-GRAVITY FLIGHT**
Debra T. Krupa, John Gosbee, Roger Billica (Krug International, Houston, TX.), and Joey B. Boyce *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 59-70 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

**N91-32782*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**ATLS: CATHETER AND TUBE PLACEMENT**
John Gosbee, Debra T. Krupa, L. Pepper, and Debra Orsak (McDonnell-Douglas Space Systems Co., Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 71-82 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

**N91-32783*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**EVALUATION OF AEROSOLIZED MEDICATIONS DURING PARABOLIC FLIGHT MANEUVERS**
Charles W. Lloyd, William J. Martin, and John Gosbee (Krug International, Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 83-96 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

**N91-32786*#** Krug International, Houston, TX.
**MINOR SURGERY IN MICROGRAVITY**
Roger Billica, Debra T. Krupa, Robert Stonestreet, and Victor D. Kizzee *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 121-130 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

**N91-32788*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**VENIPUNCTURE AND INTRAVENOUS INFUSION ACCESS DURING ZERO-GRAVITY FLIGHT**
Debra T. Krupa, John Gosbee, Roger Billica, Perry Bechtle, Gerald J. Creager (Krug International, Houston, TX.), and Joey B. Boyce *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 145-162 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

**N91-32789*#** Krug International, Houston, TX.
**EVALUATION OF CARDIOPULMONARY RESUSCITATION TECHNIQUES IN MICROGRAVITY**
Roger Billica, John Gosbee, and Debra T. Krupa *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 163-183 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

**N91-32790*#** Krug International, Houston, TX.
**FLUID HANDLING 2: SURGICAL APPLICATIONS**
Roger Billica, John Young (Texas Univ. Health Science Center, San Antonio.), Doug Rushing, and Victor D. Kizzee *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 185-192 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

# 53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**N91-32771** Maryland Univ., College Park.
**COGNITIVE CYBERNETICS AND HUMAN COMMUNICATION: THE REGULATORY EFFECTS OF PRIOR KNOWLEDGE Ph.D. Thesis**
Walton Burrell Bishop 1990 368 p
Avail: Univ. Microfilms Order No. DA9110273

The theory behind a way to measure the effectiveness of human communication and an experiment designed to test the theory are described. The theory says that we must measure a message recipient's prior knowledge and use this information to improve messages in a cognitive cybernetic manner, that is, in a way that permits the prior knowledge of intended message recipients to control the complexity and redundancy of messages. Thus, the theory suggests that information theory should be modified to consider the effects of message interpretation by message recipients. The experiment, conducted over a three-year period at the University of Maryland, involved 398 undergraduate students. Interviews conducted in 1987 provided information needed for the pilot tests of 1988. The pilot tests showed how to design a two-phase experiment in which information from Phase 1 would provide data that could be analyzed by the Galileo multidimensional scaling system. The Galileo system's results were expected to show how a science article could be modified to make it either easier or more difficult for Phase 2 students to understand. The experiment's results indicate that students who read an improved article, in which all improvements were based upon Galileo results, scored significantly higher on a discipline test than those who read a degraded article were not consistent enough to produce any conclusive results. In general, the experiment's findings support the theory that a multidimensional scaling system can be used to determine some of the effects of subjects' prior knowledge, and information concerning these effects can be used to improve the comprehensibility of messages to

specific audiences. The ability to measure effects of relevant prior knowledge may be used to help explain why different people often get different meanings from the same message. To test the theory further, the study recommends using the Galileo multidimensional scaling system to measure the effectiveness of science textbooks. Dissert. Abstr.

**N91-32772#** Cranfield Inst. of Tech., Bedford (England). Applied Psychology Unit.
**AN INVESTIGATION INTO THE POTENTIAL USE OF PSYCHOMETRIC INSTRUMENTS FOR THE SELECTION OF FIREARMS OFFICERS**
Susan Gleave, John Harris, and Andrew Guppy Apr. 1991 21 p
(Cranfield-Aero-9108; ISBN-1-871564-29-8; ETN-91-99897)
Avail: NTIS HC/MF A03; Cranfield Inst. of Tech., Coll. of Aeronautics, Cranfield, Bedford MK43 0AL, England, HC 8 sterling pounds

The aim of this study was to identify a way of assisting the development of the psychological aspects of the current selection procedure for firearms applicants. It was decided that this would be best satisfied with the development of a job performance criterion measure that would reliably differentiate between officers. A reliable criterion method was not achieved at the macro level, as no one method (behavior versus traits) was seen to be more reliable than the other. The aim may be satisfied in that the clusters of the behaviors and traits yielded three very respectable inter judge reliabilities; therefore a combination of these three clusters may satisfy the aim and offer a reliable criterion on which to improve selection. ESA

**N91-32773#** Air Force Human Resources Lab., Williams AFB, AZ. Aircrew Training Research Div.
**AIRCREW PART-TASK TRAINING RESEARCH AND DEVELOPMENT IN THE 1980S: LESSONS LEARNED Final Technical Report, Jan. 1982 - Mar. 1991**
Thomas H. Gray and Bernell J. Edwards Jun. 1991 26 p
(AF Proj. 1123)
(AD-A239456; AL-TR-1991-0005) Avail: NTIS HC/MF A03 CSCL 05/9

Throughout the 1980s the Aircrew Training Research Division of the Human Resources Directorate, Armstrong Laboratory sponsored various research and development (R and D) activities involving part-task training concepts. The R and D accomplished during this period was fueled by training device cost considerations, unit-level training needs, applications of new approaches in cognitive science, and the explosive development of the microprocessor. In total, seven part-task training devices were developed by this division. This report describes these devices and the research performed using them. In addition, the 'lessons learned' from research, as well as suggestions for future research in part-task training, are discussed. GRA

**N91-32774#** Oak Ridge National Lab., TN.
**MODELS OF HUMAN OPERATORS: THEIR NEED AND USEFULNESS FOR IMPROVEMENT OF ADVANCED CONTROL SYSTEMS AND CONTROL ROOMS**
H. E. Knee and J. C. Schryver 1991 11 p Presented at the International Conference on Fast Reactor Systems and Fuel Cycles, Kyoto (Japan), 27-31 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017245; CONF-911001-2) Avail: NTIS HC/MF A03

Models of human behavior and cognition (HB&C) are necessary for understanding the total response of complex systems. Many such model have come available over the past thirty years for various applications. Many potential model users remain skeptical about their practically, acceptability, and usefulness. Such hesitancy stems in part from disbelief in the ability to model complex cognitive processes, and a belief that relevant human behavior can be adequately accounted for through the use of common-sense heuristics. This paper will highlight several models of HB&C and identify existing and potential applications in attempt to dispel such notions. DOE

# 54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

**N91-32775#** Army Natick Research and Development Command, MA.
**HUMAN ANALOGUE MODELS FOR COMPUTER-AIDED DESIGN AND ENGINEERING APPLICATIONS Final Report, Nov. 1988 - Jul. 1990**
Steven P. Paquette Nov. 1990 42 p
(DA Proj. 161-62786-AH-98)
(AD-A229520; NATICK/TR/90/054) Avail: NTIS HC/MF A03 CSCL 23/2

A review of six computerized human analogue models (SAMMIE, COMBIMAN, CREW CHIEF, CAR, JACK, and SAFEWORK) was conducted to identify the state-of-the-art in ergonomic modeling software. All of the models included here demonstrate some utility as ergonomic design tools and were developed so that material designers and engineers can conduct preliminary human factors analysis prior to prototype construction. These human figure models vary widely with respect to primary function and analytical capabilities. However, they essentially fall within one or more of the following categories: anthropometric accommodation analysis, biomechanical/strength modeling, or human-machine interface analysis. This report includes the developmental background of each model, the hardware requirements, and the major functions provided by each system, e.g., reach/clearance analysis, vision analysis, strength modeling, and computer simulation. The underlying anthropometric databases that support model generation are also reviewed. In addition, the techniques used to construct the human figures in terms of skeletal link structure and geometric representation of body segment shape and volume are discussed. Finally, some challenges are presented that confront future refinement of human figure models. GRA

**N91-32776*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**MEDICAL EVALUATIONS ON THE KC-135 1990 FLIGHT REPORT SUMMARY**
Charles W. Lloyd, Terrell M. Guess, Charles W. Whiting, and Charles R. Doarn (Krug Life Sciences, Inc., Houston, TX.) Sep. 1991 243 p
(Contract NAS9-18492)
(NASA-TM-104740; S-646; NAS 1.15:104740) Avail: NTIS HC/MF A11 CSCL 05H

The medical investigations completed on the KC-135 during FY 1990 in support of the development of the Health Maintenance Facility and Medical Operations are discussed. The experiments are comprised of engineering evaluations of medical hardware and medical procedures. The investigating teams are made up of both medical and engineering personnel responsible for the development of medical hardware and medical operations. The hardware evaluated includes dental equipment, a coagulation analyzer, selected pharmaceutical aerosol devices, a prototype air/fluid separator, a prototype packaging and stowage system for medical supplies, a microliter metering system, and a workstation for minor surgical procedures. The results of these engineering evaluations will be used in the design of fleet hardware as well as to identify hardware specific training requirements. For individual titles, see N91-32777 through N91-32794.

**N91-32777*#** Texas Univ. Health Science Center, San Antonio.
**HEALTH MAINTENANCE FACILITY: DENTAL EQUIPMENT REQUIREMENTS** **c52**
John Young, John Gosbee, and Roger Billica (Krug International, Houston, TX.) *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 1-4 (For primary document see N91-32776

24-54)
Avail: NTIS HC/MF A11 CSCL 06E

The objectives were to test the effectiveness of the Health Maintenance Facility (HMF) dental suction/particle containment system, which controls fluids and debris generated during simulated dental treatment, in microgravity; to test the effectiveness of fiber optic intraoral lighting systems in microgravity, while simulating dental treatment; and to evaluate the operation and function of off-the-shelf dental handheld instruments, namely a portable dental hand drill and temporary filling material, in microgravity. A description of test procedures, including test set-up, flight equipment, and the data acquisition system, is given. Author

**N91-32778*#** Texas Univ. Health Science Center, San Antonio.
**DENTAL EQUIPMENT TEST DURING ZERO-GRAVITY FLIGHT** **c52**

John Young, John Gosbee, and Roger Billica (Krug International, Houston, TX.) *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 5-19 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

The overall objectives of this program were to establish performance criteria and develop prototype equipment for use in the Health Maintenance Facility (HMF) in meeting the needs of dental emergencies during space missions. The primary efforts during this flight test were to test patient-operator relationships, patent (manikin) restraint and positioning, task lighting systems, use and operation of dental rotary instruments, suction and particle containment system, dental hand instrument delivery and control procedures, and the use of dental treatment materials. The initial efforts during the flight focused on verification of the efficiency of the particle containment system. An absorptive barrier was also tested in lieu of the suction collector. To test the instrument delivery system, teeth in the manikin were prepared with the dental drill to receive restorations, some with temporary filling materials and another with definitive filling material (composite resin). The best particle containment came from the combination use of the laminar-air/suction collector in concert with immediate area suction from a surgical high-volume suction tip. Lighting in the treatment area was provided by a flexible fiberoptic probe. This system is quite effective for small areas, but for general tasks ambient illumination is required. The instrument containment system (elastic cord network) was extremely effective and easy to use. The most serious problem with instrument delivey and actual treatment was lack of time during the microgravity sequences. The restorative materials handled and finished well. Author

**N91-32779*#** Krug International, Houston, TX.
**MINI-RACK TESTBED EVALUATION**

John Gosbee, Barbara Stegmann, and Terrell M. Guess (Krug Life Sciences, Inc., Houston, TX.) *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 21-40 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 05H

The goal was to characterize the Health Maintenance Facility (HMF)-like mini-racks and drawers onboard the KC-135 as a test bed for the Space Station Freedom HMF racks. An additional goal was to evaluate the attachments, mounting points, and inner drawer assemblies of the mini-racks for various medical equipment and supplies. Results and recommendations are given. Author

**N91-32780*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**OPERATION AND PERFORMANCE OF THE CIBA-CORNING 512 COAGULATION MONITOR DURING PARABOLIC FLIGHT** **c52**

Robyn Gocke, Charles W. Lloyd, and Nancy K. Greenthaner (Krug Life Sciences, Inc., Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 41-58 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

The goal was to assess the functionality and evaluate the procedures and operations required to operate the Ciba-Corning 512 Coagulation Monitor during parabolic flight. This monitor determines the clotting characteristics of blood. The analyzer operates by laser detection of the cessation of blood flow in a capillary channel within a test cartridge. Test simulator results were excellent for both pre-and post-flight. In-flight results were not obtained due to the warm-up time required for the simulator. Since this is an electronic function only, the expected results on the simulator would be the same in zero-g. Author

**N91-32781*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**APPLICATION AND USE OF SPINAL IMMOBILIZATION DEVICES IN ZERO-GRAVITY FLIGHT** **c52**

Debra T. Krupa, John Gosbee, Roger Billica (Krug International, Houston, TX.), and Joey B. Boyce *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 59-70 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

A KC-135 parabolic flight was performed for the purpose of evaluation of spinal immobilization techniques in microgravity. The flight followed the standard 40 parabola profile with four NASA/KRUG experimenters involved. One performed as coordinator/recorder, one as test subject, and two as the Crew Medical Officers (CMO). The flight was to evaluate the application of spinal immobilization devices and techniques in microgravity as are performed during initial stabilization or patient transport scenarios. The sequence of detail for examination of the following objectives included: attempted cervical spine immobilization with all free floating, the patient restrained to the floor, various hand positioning techniques; c-collar placement; Kendrick Extrication Device (KED) application with various restraints for patient and CMO; patient immobilization and transport using the KED; patient transported on KED and spine board. Observations for each task are included. Major conclusions and issues are also included.
Author

**N91-32782*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**ATLS: CATHETER AND TUBE PLACEMENT** **c52**

John Gosbee, Debra T. Krupa, L. Pepper, and Debra Orsak (McDonnell-Douglas Space Systems Co., Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 71-82 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

The specific objectives of this experiment are: to evaluate the rack mounted equipment and medical supplies necessary for medical procedures; to evaluate the attachments, mounting points, and inner drawer assemblies for the medical supplies; and to evaluate the procedures for performing medical scenarios. The resources available in the HMF miniracks to accomplish medical scenarios and/or procedures include: medical equipment mounted in the racks; a patch panel with places to attach tubing and catheters; self contained drawers full of critical care medical supplies; and an ALS 'backpack' for deploying supplies. The attachment lines, tubing and associated medical supplies will be deployed and used with the equipment and a patient mannequin. Data collection is provided by direct observations by the inflight experimenters, and analysis of still and video photography.
Author

**N91-32783*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**EVALUATION OF AEROSOLIZED MEDICATIONS DURING PARABOLIC FLIGHT MANEUVERS** **c52**

Charles W. Lloyd, William J. Martin, and John Gosbee (Krug International, Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 83-96 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

The goal was to visually evaluate the effect gravity has on

delivery of medications by the use of various aerosol devices. During parabolic flight the same four aerosols were retested as performed in studio ground tests. It appears that the Cetacaine spray and the Ventolin inhaler function without failure during all test. The pump spray (Nostril) appeared to function normally when the container was full, however it appeared to begin to fail to deliver a full mist with larger droplet size when the container was nearly empty. The simple hand spray bottle appeared to work when the container was full and performed progressively worse as the container was emptied. During Apollo flights, it was reported that standard spray bottles did not work well, however, they did not indicate why. It appears that we would also conclude that standard spray bottles do not function as well in zero gravity by failing to produce a normal mist spray. The standard spray bottle allowed the fluid to come out in a narrow fluid stream when held with the nozzle either level or slightly tilted upward. Author

**N91-32784*#** Krug International, Houston, TX.
**TRANSPORT SUCTION APPARATUS AND ABSORPTION MATERIALS EVALUATION**
Debra T. Krupa and John Gosbee *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 97-108 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 05H

The specific objectives were as follows. The effectiveness and function was evaluated of the hand held, manually powered v-vac for suction during microgravity. The function was evaluated of the battery powered laerdal suction unit in microgravity. The two units in control of various types of simulated bodily fluids were compared. Various types of tubing and attachments were evaluated which are required to control the collection of bodily fluids during transport. Various materials were evaluated for absorption of simulated bodily fluids. And potential problems were identified for waste management and containment of secretions and fluids during transport. Test procedures, results, and conclusions are briefly discussed. Author

**N91-32785*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**ATLS-STOWAGE AND DEPLOYMENT TESTING OF MEDICAL SUPPLIES AND PHARMACEUTICALS**
John Gosbee, Darren Benz, Charles W. Lloyd, Richard Bueker, and Debra Orsak (McDonnell-Douglas Space Systems Co., Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 109-119 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 05H

The objective is to evaluate stowage and deployment methods for the Health Maintenance Facility (HMF) during microgravity. The specific objectives of this experiment are: (1) to evaluate the stowage and deployment mechanisms for the medical supplies; and (2) to evaluate the procedures for performing medical scenarios. To accomplish these objectives, the HMF test mini-racks will contain medical equipment mounted in the racks; and self-contained drawers with various mechanisms for stowing and deploying items. The medical supplies and pharmaceuticals will be destowed, handled, and restowed. The in-flight test procedures and other aspects of the KC-135 parabolic flight test to simulate weightlessness are presented. Author

**N91-32786*#** Krug International, Houston, TX.
**MINOR SURGERY IN MICROGRAVITY** **c52**
Roger Billica, Debra T. Krupa, Robert Stonestreet, and Victor D. Kizzee *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 121-130 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

The purpose is to investigate and demonstrate equipment and techniques proposed for minor surgery on Space Station Freedom (SSF). The objectives are: (1) to test and evaluate methods of surgical instrument packaging and deployment; (2) to test and evaluate methods of surgical site preparation and draping; (3) to evaluate techniques of sterile procedure and maintaining sterile field; (4) to evaluate methods of trash management during medical/surgical procedures; and (4) to gain experience in techniques for performing surgery in microgravity. A KC-135 parabolic flight test was performed on March 30, 1990 with the goal of investigating and demonstrating surgical equipment and techniques under consideration for use on SSF. The flight followed the standard 40 parabola profile with 20 to 25 seconds of near-zero gravity in each parabola. Author

**N91-32787*#** Krug International, Houston, TX.
**EVALUATION OF PROTOTYPE ADVANCED LIFE SUPPORT (ALS) PACK FOR USE BY THE HEALTH MAINTENANCE FACILITY (HMF) ON SPACE STATION FREEDOM (SSF)**
Debra T. Krupa, John Gosbee, Linda Murphy, and Victor D. Kizzee *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 131-143 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 05H

The purpose is to evaluate the prototype Advanced Life Support (ALS) Pack which was developed for the Health Maintenance Facility (HMF). This pack will enable the Crew Medical Officer (CMO) to have ready access to advanced life support supplies and equipment for time critical responses to any situation within the Space Station Freedom. The objectives are: (1) to evaluate the design of the pack; and (2) to collect comments for revision to the design of the pack. The in-flight test procedures and other aspects of the KC-135 parabolic test flight to simulate weightlessness are presented. Author

**N91-32788*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**VENIPUNCTURE AND INTRAVENOUS INFUSION ACCESS DURING ZERO-GRAVITY FLIGHT** **c52**
Debra T. Krupa, John Gosbee, Roger Billica, Perry Bechtle, Gerald J. Creager (Krug International, Houston, TX.), and Joey B. Boyce *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 145-162 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

The purpose of this experiment is to establish the difficulty associated with securing an intravenous (IV) catheter in place in microgravity flight and the techniques applicable in training the Crew Medical Officer (CMO) for Space Station Freedom, as well as aiding in the selection of appropriate hardware and supplies for the Health Maintenance Facility (HMF). The objectives are the following: (1) to determine the difficulties associated with venipuncture in a microgravity environment; (2) to evaluate the various methods of securing an IV catheter and attached tubing for infusion with regard to the unique environment; (3) to evaluate the various materials available for securing an intravenous catheter in place; and (4) to evaluate the fluid therapy administration system when functioning in a complete system. The inflight test procedures and other aspects of the KC-135 parabolic flight test to simulate microgravity are presented. Author

**N91-32789*#** Krug International, Houston, TX.
**EVALUATION OF CARDIOPULMONARY RESUSCITATION TECHNIQUES IN MICROGRAVITY** **c52**
Roger Billica, John Gosbee, and Debra T. Krupa *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 163-183 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

Cardiopulmonary resuscitation (CPR) techniques were investigated in microgravity with specific application to planned medical capabilities for Space Station Freedom (SSF). A KC-135 parabolic flight test was performed with the goal of evaluating and quantifying the efficacy of different types of microgravity CPR techniques. The flight followed the standard 40 parabola profile with 20 to 25 seconds of near-zero gravity in each parabola. Three

experiments were involved chosen for their clinical background, certification, and practical experience in prior KC-135 parabolic flight. The CPR evaluation was performed using a standard training mannequin (recording resusci-Annie) which was used in practice prior to the actual flight. Aboard the KC-135, the prototype medical restraint system (MRS) for the SSF Health Maintenance Facility (HMF) was used for part of the study. Standard patient and crew restraints were used for interface with the MRS. During the portion of study where CPR was performed without MRS, a set of straps for crew restraint similar to those currently employed for the Space Shuttle program were used. The entire study was recorded via still camera and video. Author

**N91-32790*#** Krug International, Houston, TX.
**FLUID HANDLING 2: SURGICAL APPLICATIONS c52**
Roger Billica, John Young (Texas Univ. Health Science Center, San Antonio.), Doug Rushing, and Victor D. Kizzee *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 185-192 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 06E

The methods proposed for managing fluids and particulate debris during minor surgery on Space Station Freedom (SSF) were investigated and demonstrated. A KC-135 parabolic flight test was performed, in which the flight followed the standard 40 parabola profile with 20 to 25 seconds in near-zero gravity in each parabola. The equipment (suction and laminar flow device) was evaluated. While this equipment performed satisfactorily previously in the dental simulation, the purpose of the current flight was to reconfigure the equipment in support of a minor surgical situation in order to evaluate its efficacy and establish clear requirements for the actual flight hardware. To accomplish the study the Health Maintenance Facility medical restraint system was deployed as for surgical use and mannequin suture arm was restrained to its surface. The surgical area was established as for performing minor surgery with standard tray and suture instruments employed. Author

**N91-32791*#** Krug International, Houston, TX.
**EVALUATION OF PROTOTYPE AIR/FLUID SEPARATOR FOR SPACE STATION FREEDOM HEALTH MAINTENANCE FACILITY**
Roger Billica, Maureen Smith, Linda Murphy, and Victor D. Kizzee *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 193-203 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 05H

A prototype air/fluid separator suction apparatus proposed as a possible design for use with the Health Maintenance Facility aboard Space Station Freedom (SSF) was evaluated. A KC-135 parabolic flight test was performed for this purpose. The flights followed the standard 40 parabola profile with 20 to 25 seconds of near-zero gravity in each parabola. A protocol was prepared to evaluate the prototype device in several regulator modes (or suction force), using three fluids of varying viscosity, and using either continuous or intermittent suction. It was felt that a matrixed approach would best approximate the range of utilization anticipated for medical suction on SSF. The protocols were performed in one-gravity in a lab setting to familiarize the team with procedures and techniques. Identical steps were performed aboard the KC-135 during parabolic flight. Author

**N91-32792*#** Eastman Kodak Co., Rochester, NY.
**PRECISION METERING OF MICROLITER VOLUMES OF BIOLOGICAL FLUIDS IN MICRO-GRAVITY**
Richard L. Columbus, Harvey J. Palmer, B. A. McKinley, William T. Norfleet, and Victor D. Kizzee (Krug Life Sciences, Inc., Houston, TX.) *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 205-211 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 05H

Concepts were demonstrated and investigated for transferring accurately known and reproducible microliter volumes of biological fluids from sample container onto dry chemistry slides in microgravity environment. Specific liquid transfer tip designs were compared. Information was obtained for design of a liquid sample handling system to enable clinical chemical analysis in microgravity. Disposable pipet tips and pipet devices that were designed to transfer microliter volumes of biological fluid from a (test tube) sample container in 1-G environment were used during microgravity periods of parabolic trajectories of the KC-135 aircraft. The transfer process was recorded using charge coupled device camera and video cassette equipment. Metering behavior of water, a synthetic aqueous protein solution, and anticoagulated human blood was compared. Transfer of these liquids to 2 substrate materials representative of rapidly wettable and slowly wettable dry chemistry slide surface was compared. Author

**N91-32793*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**SHUTTLE ORBITER MEDICAL SYSTEM EQUIPMENT/SUPPLIES EVALUATION**
Kristin Maidlow, John M. Schulz, Charles W. Lloyd, and Tiffany Breeding (Krug International, Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 213-236 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 05H

The effectivity was evaluated in zero gravity of several medical equipment and supply items flown in the Shuttle Orbiter Medical System (SOMS). Several procedures listed in Medical Operations Medical Checklist, JSC 1732 were also evaluated. Several items were drawn out of the kits and tested on the KC-135. In two different flights, the following elements were examined: (1) measuring IV flow (drip chamber, one way flow valve, and air/fluid separator); (2) chemstrip protocol for urine analysis in zero-gravity; and (3) tamper resistant seals for injectable medications. Author

**N91-32794*#** Georgetown Univ., Washington, DC.
**DEPLOYMENT AND TESTING OF A SECOND PROTOTYPE EXPANDABLE SURGICAL CHAMBER IN MICROGRAVITY**
Sanford M. Markham and John A. Rock (Johns Hopkins Univ., Baltimore, MD.) *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary Sep. 1991 p 237-239 (For primary document see N91-32776 24-54)
Avail: NTIS HC/MF A11 CSCL 05H

During microgravity exposure, two separate expandable surgical chambers were tested. Both chambers had been modified to fit the microgravity work station without extending over the sides of the table. Both chambers were attached to a portable laminar flow generator which served two purposes: to keep the chambers expanded during use; and to provide an operative area environment free of contamination. During the tests, the chambers were placed on various parts of a total body moulage to simulate management of several types of trauma. The tests consisted of cleansing contusions, debridement of burns, and suturing of lacerations. Also, indigo carmine dye was deliberately injected into the chamber during the tests to determine the ease of cleansing the chamber walls after contamination by escaping fluids. Upon completion of the tests, the expandable surgical chambers were deflated, folded, and placed in a flattened state back into their original containers for storage and later disposal. Results are briefly discussed. Author

**N91-32795*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**ROTATIONALLY ACTUATED PROSTHETIC HELPING HAND Patent**
William E. Norton, inventor (to NASA), Jewell G. Belcher, Jr., inventor (to NASA), James R. Carden, inventor (to NASA), and Thomas W. West, inventor (to NASA) 4 Jun. 1991 10 p Filed 12 Apr. 1990 Supersedes N90-27261 (28 - 21, p 3036)
(NASA-Case-MFS-28426-1; US-Patent-5,021,065;
US-Patent-Appl-SN-508154; US-Patent-Class-623-63;

US-Patent-Class-623-62; Int-Patent-Class-A61F-2/58; Int-Patent-Class-A61F-2/68) Avail: US Patent and Trademark Office CSCL 06K

A prosthetic device has been developed for below-the-elbow amputees. The device consists of a cuff, a stem, a housing, two hook-like fingers, an elastic band for holding the fingers together, and a brace. The fingers are pivotally mounted on a housing that is secured to the amputee's upper arm with the brace. The stem, which also contains a cam, is rotationally mounted within the housing and is secured to the cuff, which fits over the amputee's stump. By rotating the cammed stem between the fingers with the lower arm, the amputee can open and close the fingers.

Official Gazette of the U.S. Patent and Trademark Office

# 55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

# 59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

# 60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

**N91-32796#** Harry Diamond Labs., Adelphi, MD.
**ANALOG-TO-DIGITAL CONVERSION TECHNIQUES Final Report, period ending May 1990**
Clyde C. DeLuca Jul. 1991 18 p
(AD-A239469; HDL-SR-91-5) Avail: NTIS HC/MF A03 CSCL 09/1

Various types of analog-to-digital converters (ADC's) are currently on the market. Intended to familiarize the reader with different ADC's, this report examines three specific types: integrating, successive approximation, and flash or parallel and subranging converters. The methods by which these ADC's process signals are discussed, in addition to their common uses. This report also includes a brief market survey which demonstrates the many ADC's that are available from different manufacturers. GRA

**N91-32797*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**RECOGNITION OF SIMPLE VISUAL IMAGES USING A SPARSE DISTRIBUTED MEMORY: SOME IMPLEMENTATIONS AND EXPERIMENTS**
Louis A. Jaeckel Mar. 1990 58 p Sponsored in part by USRA
(Contracts NCC2-387; NCC2-408)
(NASA-CR-186616; NAS 1.26:186616; RIACS-TR-90-11) Avail: NTIS HC/MF A04 CSCL 09B

Previously, a method was described of representing a class of simple visual images so that they could be used with a Sparse Distributed Memory (SDM). Herein, two possible implementations are described of a SDM, for which these images, suitably encoded, will serve both as addresses to the memory and as data to be stored in the memory. A key feature of both implementations is that a pattern that is represented as an unordered set with a variable number of members can be used as an address to the memory. In the 1st model, an image is encoded as a 9072 bit string to be used as a read or write address; the bit string may also be used as data to be stored in the memory. Another representation, in which an image is encoded as a 256 bit string, may be used with either model as data to be stored in the memory, but not as an address. In the 2nd model, an image is not represented as a vector of fixed length to be used as an address. Instead, a rule is given for determining which memory locations are to be activated in response to an encoded image. This activation rule treats the pieces of an image as an unordered set. With this model, the memory can be simulated, based on a method of computing the approximate result of a read operation. Author

**N91-32798*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**THE CORTEX TRANSFORM AS AN IMAGE PREPROCESSOR FOR SPARSE DISTRIBUTED MEMORY: AN INITIAL STUDY**
Bruno Olshausen and Andrew Watson Feb. 1990 19 p Sponsored in part by USRA
(Contracts NCC2-387; NCC2-408)
(NASA-CR-187436; NAS 1.26:187436; RIACS-TR-90-4) Avail: NTIS HC/MF A03 CSCL 09B

An experiment is described which was designed to evaluate the use of the Cortex Transform as an image processor for Sparse Distributed Memory (SDM). In the experiment, a set of images were injected with Gaussian noise, preprocessed with the Cortex Transform, and then encoded into bit patterns. The various spatial frequency bands of the Cortex Transform were encoded separately so that they could be evaluated based on their ability to properly cluster patterns belonging to the same class. The results of this study indicate that by simply encoding the low pass band of the Cortex Transform, a very suitable input representation for the SDM can be achieved. Author

**N91-32799*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**DEVELOPMENT OF A SENSOR COORDINATED KINEMATIC MODEL FOR NEURAL NETWORK CONTROLLER TRAINING**
Charles C. Jorgensen Aug. 1990 25 p Sponsored in part by USRA
(Contract NCC2-387)
(NASA-CR-188864; NAS 1.26:188864; RIACS-TR-90-28) Avail: NTIS HC/MF A03 CSCL 09B

A robotic benchmark problem useful for evaluating alternative neural network controllers is presented. Specifically, it derives two camera models and the kinematic equations of a multiple degree of freedom manipulator whose end effector is under observation. The mapping developed include forward and inverse translations from binocular images to 3-D target position and the inverse kinematics of mapping point positions into manipulator commands in joint space. Implementation is detailed for a three degree of freedom manipulator with one revolute joint at the base and two prismatic joints on the arms. The example is restricted to operate within a unit cube with arm links of 0.6 and 0.4 units respectively. The development is presented in the context of more complex simulations and a logical path for extension of the benchmark to higher degree of freedom manipulators is presented. Author

**N91-32800*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**WORKSHOP ON NASA WORKSTATION TECHNOLOGY Final Report**
Robert L. Brown Jul. 1990 38 p Sponsored in part by USRA
(Contract NCC2-387)
(NASA-CR-188866; NAS 1.26:188866; RIACS-TR-90-30) Avail: NTIS HC/MF A03 CSCL 09B

RIACS hosted a workshop which was designed to foster

communication among those people within NASA working on workstation related technology, to share technology, and to learn about new developments and futures in the larger university and industrial workstation communities. Herein, the workshop is documented along with its conclusions. It was learned that there is both a large amount of commonality of requirements and a wide variation in the modernness of in-use technology among the represented NASA centers. Author

**N91-32801*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**AN ASSESSMENT OF THE CONNECTION MACHINE**
Robert Schreiber Jun. 1990 18 p
(Contract NCC2-387)
(NASA-CR-188876; NAS 1.26:188876; RIACS-TR-90-40) Avail: NTIS HC/MF A03 CSCL 09B

The CM-2 is an example of a connection machine. The strengths and problems of this implementation are considered as well as important issues in the architecture and programming environment of connection machines in general. These are contrasted to the same issues in Multiple Instruction/Multiple Data (MIMD) microprocessors and multicomputers. Author

**N91-32802*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**EFFICIENT PACKING OF PATTERNS IN SPARSE DISTRIBUTED MEMORY BY SELECTIVE WEIGHTING OF INPUT BITS**
Pentti Kanerva Mar. 1991 10 p Presented at the Proceedings of the International Conference on Artificial Neutral Networks, Espoo, Finland, 1991 Sponsored in part by Academy of Finland Submitted for publication
(Contract NCC2-387)
(NASA-CR-188890; NAS 1.26:188890; RIACS-TR-91-08) Avail: NTIS HC/MF A02 CSCL 09B

When a set of patterns is stored in a distributed memory, any given storage location participates in the storage of many patterns. From the perspective of any one stored pattern, the other patterns act as noise, and such noise limits the memory's storage capacity. The more similar the retrieval cues for two patterns are, the more the patterns interfere with each other in memory, and the harder it is to separate them on retrieval. A method is described of weighting the retrieval cues to reduce such interference and thus to improve the separability of patterns that have similar cues. Author

**N91-32803*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**AUTOMATED IDEF3 AND IDEF4 SYSTEMS DESIGN SPECIFICATION DOCUMENT Interim Technical Report, 20 Nov. - 19 Dec. 1989**
Patricia Griffith Friel and Thomas M. Blinn (Knowledge Based Systems, Inc. College Station, TX.) 19 Dec. 1989 91 p
(Contract NCC9-16; RICIS Proj. IM-15)
(NASA-CR-188830; NAS 1.26:188830) Avail: NTIS HC/MF A05 CSCL 09B

The current design is presented for the automated IDEF3 and IDEF4 tools. The philosophy is described behind the tool designs as well as the conceptual view of the interacting components of the two tools. Finally, a detailed description is presented of the existing designs for the tools using IDEF3 process descriptions and IDEF4 diagrams. In the preparation of these designs, the IDEF3 and IDEF4 methodologies were very effective in defining the structure and operation of the tools. The experience in designing systems in this fashion was very valuable and resulted in future systems being designed in this way. However, the number of IDEF3 and IDEF4 diagrams that were produced using a Macintosh for this document attest to the need for an automated tool to simplify this design process. Author

**N91-32804*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**IDEF3 AND IDEF4 AUTOMATION SYSTEM REQUIREMENTS DOCUMENT AND SYSTEM ENVIRONMENT MODELS Interim Technical Report, 1 Aug. - 20 Nov. 1989**
Thomas M. Blinn (Knowledge Based Systems, Inc. College Station, TX.) 20 Nov. 1989 316 p
(Contract NCC9-16; RICIS Proj. IM-15)
(NASA-CR-188829; NAS 1.26:188829) Avail: NTIS HC/MF A14 CSCL 09B

The requirements specification is provided for the IDEF3 and IDEF4 tools that provide automated support for IDEF3 and IDEF4 modeling. The IDEF3 method is a scenario driven process flow description capture method intended to be used by domain experts to represent the knowledge about how a particular system or process works. The IDEF3 method provides modes to represent both (1) Process Flow Description to capture the relationships between actions within the context of a specific scenario, and (2) Object State Transition to capture the allowable transitions of an object in the domain. The IDEF4 method provides a method for capturing the (1) Class Submodel or object hierarchy, (2) Method Submodel or the procedures associated with each classes of objects, and (3) the Dispath Matching or the relationships between the objects and methods in the object oriented design. The requirements specified describe the capabilities that a fully functional IDEF3 or IDEF4 automated tool should support. Author

**N91-32805*#** National Aeronautics and Space Administration. Pasadena Office, CA.
**HIGHLY PARALLEL COMPUTER ARCHITECTURE FOR ROBOTIC COMPUTATION Patent Application**
Amir Fijany, inventor (to NASA) and Anta K. Bejczy, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 10 Jun. 1991 28 p
(Contract NAS7-918)
(NASA-Case-NPO-17632-1-CU; NAS 1.71:NPO-17632-1-CU; US-Patent-Appl-SN-712796) Avail: NTIS HC/MF A03 CSCL 09B

In a computer having a large number of single instruction multiple data (SIMD) processors, each of the SIMD processors has two sets of three individual processor elements controlled by a master control unit and interconnected among a plurality of register file units where data is stored. The register files input and output data in synchronism with a minor cycle clock under control of two slave control units controlling the register file units connected to respective ones of the two sets of processor elements. Depending upon which ones of the register file units are enabled to store or transmit data during a particular minor clock cycle, the processor elements within an SIMD processor are connected in rings or in pipeline arrays, and may exchange data with the internal bus or with neighboring SIMD processors through interface units controlled by respective ones of the two slave control units. NASA

**N91-32294#** Societe d'Applications Generales d'Electricite et de Mecanique, Cergy-Pontoise (France).
**NON VOLATILE SOLID STATE MAGNETIC MEMORY TECHNOLOGIES**
Michel A. Poirier *In* ESA, ESA Electronic Components Conference Mar. 1991 p 25-29 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32295#** Interuniversity Micro-Electronics Center, Leuven (Belgium).
**NEW DEVELOPMENTS IN NON-VOLATILE SEMICONDUCTOR MEMORY TECHNOLOGIES AND DEVICES**
H. E. Maes, G. Groeseneken, and J. Witters (MIETEC, Oudenaarde, Belgium ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 31-42 (For primary document see N91-32291

24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32329#** LABEN Ferranti International, Vimodrone (Italy).
**A SOLID STATE MASS MEMORY FOR SPACE APPLICATIONS: TECHNOLOGICAL AND SYSTEM ASPECTS**
F. Longoni, G. Simonetti, and A. Zambra *In* ESA, ESA Electronic Components Conference Mar. 1991 p 235-241 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32357#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Components Div.
**THE PRE-SCREENING OF LARGE SEMICONDUCTOR MEMORIES FOR SPACE APPLICATION**
R. Harboe-Soerensen and R. Mueller (Technische Univ., Brunswick, Germany, F.R. ) *In its* ESA Electronic Components Conference Mar. 1991 p 427-433 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32358#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
**RADIATION ASSESSMENT OF THE INMOS TRANSPUTER FAMILY**
M. LopezCotarelo, J. A. Thompson, B. K. Hancock, and J. P. Nicholls (Satellites International Ltd., Newbury, England ) *In its* ESA Electronic Components Conference Mar. 1991 p 435-440 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

# 61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

**N91-32806*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**CRAY PERFORMANCE DATA FROM FIVE BENCHMARKS**
James A. Pennline Sep. 1991 23 p
(NASA-TM-105200; E-6503; NAS 1.15:105200) Avail: NTIS HC/MF A03 CSCL 09B
The five benchmark programs discussed in TM-88956, February 1987, were run on the CRAY X-MP/24 under different operating systems and compilers. Performance data is reported for runs under early versions of UNICOS and CFT77. The most recent data includes a system of configuration for a X-MP hardware upgrade. Performance figures for the Y-MP are shown for comparison. Differences in the figures are analyzed and discussed. Author

**N91-32807#** Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
**A FAMILY OF OPTIMALLY CONDITIONED QUASI-NEWTON UPDATES FOR UNCONSTRAINED OPTIMIZATION**
Y. F. Hu and C. Storey Apr. 1991 17 p
(MATHS-Rept-A-143; ETN-91-99888) Avail: NTIS HC/MF A03
A general optimal conditioning problem for updates which satisfy the quasi-Newton conditions is solved. The new solution is comprised of a family of updates which contains other known optimally conditioned updates but also includes new formulae of increased rank. ESA

**N91-32808** National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
**A VDM-SL SPECIFICATION FOR THE VI PATTERN MATCHER**
I. P. Dickinson Jan. 1991 16 p
(NPL-DITC-171/91; ISSN-0262-5369; ETN-91-90022) Copyright Avail: National Physical Lab., Teddington, TW11 0LW, England
The pattern matching mechanism used on the VI text editor is specified. The purpose is to give an example of the use of Vienna Development Method-Specification Language (VDM-SL), demonstrating the philosophy of abstraction of data structures so as to reflect the operations carried out upon them; and to give an example of the output of the LaTEX VDM-SL macros. ESA

**N91-32809** National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
**APPROVED Ada UNIFORMITY ISSUES**
P. D. Kenward and B. A. Wichmann Feb. 1991 34 p
(NPL-DITC-172/91; ISSN-0262-5369; ETN-91-90023) Copyright Avail: National Physical Lab., Teddington, TW11 0LW, England
The Uniformity Rapporteur Group (URG) is a technical working group which reports to the part of the international organization for standardization which handles the standardization of Ada. An introduction to the Ada URG and the Ada issues that are being discussed within the group about the standardization of the Ada programming language is given. The first batch of issues approved are reported. A full index of the current issues is given. ESA

**N91-32810** National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
**THE LANGUAGE COMPATIBLE ARITHMETIC STANDARD AND Ada**
B. A. Wichmann Feb. 1991 121 p
(NPL-DITC-173/91; ISSN-0262-5369; ETN-91-90024) Copyright Avail: National Physical Lab., Teddington, TW11 0LW, England
The Language Compatible Arithmetic Standard (LCAS) defines the numerical properties of arithmetic operations. The Ada standard and two secondary draft standards define the relevant numeric properties of Ada. The relationship between the two is studied in order to make recommendations for changes to either of the draft standards or to the revision of the Ada standard (Ada 9X). A copy of the current version of the LCAS is included. ESA

**N91-32811#** European Space Agency, Paris (France). Board for Software Standardization and Control.
**ESA SOFTWARE ENGINEERING STANDARDS, ISSUE 2**
Feb. 1991 146 p
(ESA-PSS-05-0-Issue-2; ISSN-0379-4059; ETN-91-90062)
Copyright Avail: NTIS HC/MF A07
The software engineering standards to be applied for all deliverable software implemented for the European Space Agency (ESA), either in house or by industry are described. Software is defined in these standards as the programs, procedures, rules and all associated documentation pertaining to the operation of a computerized system. These standards are concerned with all software aspects of a system, including its interfaces with the computer hardware and with other components of the system. Software may be either a subsystem of a more complex system or it may be an independent system. The ESA software engineering standards are divided into three points: (1) product standards (standards, recommendations and guidelines concerning the product, i.e., the software to be defined, implemented, operated and maintained); (2) procedure standards (the procedures which are used to manage a software project); and (3) appendices (summaries, tables, forms and checklists of mandatory practices). ESA

**N91-32812** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Visuology Group.
**ADVANCED MULTIRESOLUTION MORPHOLOGY Final Report**
A. Toet 11 Mar. 1991 50 p
(Contract A87/D/149)
(IZF-1991-A-12; TD-91-0042; ETN-91-99991) Copyright Avail:

Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Kampweg 5, Netherlands

The mathematical background of some multiresolution image representations is presented. In these representations iterative morphological filters of many scales but identical shape serve as basis functions. The representations differ from established techniques in that the primitives have a well defined location and size. Structural pattern decompositions are obtained by subtracting successive layers in the multiresolution representations. The resulting image descriptions provide a useful basis for multiresolution shape analysis and synthesis and are well suited for parallel and VLSI (Very Large Scale Integration) implementation. Moreover, it was recently demonstrated that multiresolution morphology can be used to fuse images originating from multiple sensors and/or different sensing modalities. ESA

**N91-32813** Physics and Electronics Lab. TNO, The Hague (Netherlands).

**WASP, THE WEAPON ANALYSIS AND SIMULATION PROGRAM Interim Report**

H. G. M. Janssen, N. M. deReus, P. F. Ruizendaal, and A. Wijbenga Mar. 1991 33 p

(Contract A84/KM/80)

(FEL-90-A322; TD-90-4057; ETN-91-99996) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

The analysis and simulation of guided weapons systems performed using the software package WASP is addressed. The design approach and simulation method are presented. The modular structure is described. Some possible weapon configurations are discussed, along with the utilization and maintenance of the program. Some results are shown. ESA

**N91-32814*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.

**ON POLYNOMIAL PRECONDITIONING FOR INDEFINITE HERMITIAN MATRICES**

Roland W. Freund (Wuerzburg Univ., Germany, F.R. ) Aug. 1989 34 p

(Contract NCC2-387)

(NASA-CR-188857; NAS 1.26:188857; RIACS-TR-89-32) Avail: NTIS HC/MF A03 CSCL 09B

The minimal residual method is studied combined with polynomial preconditioning for solving large linear systems (Ax = b) with indefinite Hermitian coefficient matrices (A). The standard approach for choosing the polynomial preconditioners leads to preconditioned systems which are positive definite. Here, a different strategy is studied which leaves the preconditioned coefficient matrix indefinite. More precisely, the polynomial preconditioner is designed to cluster the positive, resp. negative eigenvalues of A around 1, resp. around some negative constant. In particular, it is shown that such indefinite polynomial preconditioners can be obtained as the optimal solutions of a certain two parameter family of Chebyshev approximation problems. Some basic results are established for these approximation problems and a Remez type algorithm is sketched for their numerical solution. The problem of selecting the parameters such that the resulting indefinite polynomial preconditioners speeds up the convergence of minimal residual method optimally is also addressed. An approach is proposed based on the concept of asymptotic convergence factors. Finally, some numerical examples of indefinite polynomial preconditioners are given. Author

**N91-32815*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.

**IS THINKING COMPUTABLE?**

Peter J. Denning 31 Jan. 1990 13 p Submitted for publication Sponsored in part by USRA

(Contract NCC2-387)

(NASA-CR-188859; NAS 1.26:188859; RIACS-TR-90-2) Avail: NTIS HC/MF A03 CSCL 09B

Strong artificial intelligence claims that conscious thought can arise in computers containing the right algorithms even though none of the programs or components of those computers understand which is going on. As proof, it asserts that brains are finite webs of neurons, each with a definite function governed by the laws of physics; this web has a set of equations that can be solved (or simulated) by a sufficiently powerful computer. Strong AI claims the Turing test as a criterion of success. A recent debate in Scientific American concludes that the Turing test is not sufficient, but leaves intact the underlying premise that thought is a computable process. The recent book by Roger Penrose, however, offers a sharp challenge, arguing that the laws of quantum physics may govern mental processes and that these laws may not be computable. In every area of mathematics and physics, Penrose finds evidence of nonalgorithmic human activity and concludes that mental processes are inherently more powerful than computational processes. Author

**N91-32816*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.

**EVOLUTIONARY TREE RECONSTRUCTION**

Peter Cheeseman and Bob Kanefsky (Sterling Software, Moffett Field, CA.) Mar. 1990 8 p Sponsored in part by USRA

(Contract NCC2-387)

(NASA-CR-188862; NAS 1.26:188862; RIACS-TR-90-27) Avail: NTIS HC/MF A02 CSCL 09B

It is described how Minimum Description Length (MDL) can be applied to the problem of DNA and protein evolutionary tree reconstruction. If there is a set of mutations that transform a common ancestor into a set of the known sequences, and this description is shorter than the information to encode the known sequences directly, then strong evidence for an evolutionary relationship has been found. A heuristic algorithm is described that searches for the simplest tree (smallest MDL) that finds close to optimal trees on the test data. Various ways of extending the MDL theory to more complex evolutionary relationships are discussed. Author

**N91-32817*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.

**SAVING ALL THE BITS**

Peter J. Denning 15 Oct. 1990 15 p Submitted for publication

(Contract NCC2-387)

(NASA-CR-188879; NAS 1.26:188879; RIACS-TR-90-44) Avail: NTIS HC/MF A03 CSCL 09B

The scientific tradition of saving all the data from experiments for independent validation and for further investigation is under profound challenge by modern satellite data collectors and by supercomputers. The volume of data is beyond the capacity to store, transmit, and comprehend the data. A promising line of study is discovery machines that study the data at the collection site and transmit statistical summaries of patterns observed. Examples of discovery machines are the Autoclass system and the genetic memory system of NASA-Ames, and the proposal for knowbots by Kahn and Cerf. Author

**N91-32818*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.

**QMR: A QUASI-MINIMAL RESIDUAL METHOD FOR NON-HERMITIAN LINEAR SYSTEMS**

Roland W. Freund and Noel M. Nachtigal (Massachusetts Inst. of Tech., Cambridge.) Dec. 1990 36 p

(Contract NCC2-387)

(NASA-CR-188882; NAS 1.26:188882; RIACS-TR-90-51) Avail: NTIS HC/MF A03 CSCL 09B

The biconjugate gradient (BCG) method is the natural generalization of the classical conjugate gradient algorithm for Hermitian positive definite matrices to general non-Hermitian linear systems. Unfortunately, the original BCG algorithm is susceptible to possible breakdowns and numerical instabilities. A novel BCG like approach is presented called the quasi-minimal residual (QMR) method, which overcomes the problems of BCG. An implementation of QMR based on a look-ahead version of the nonsymmetric Lanczos algorithm is proposed. It is shown how BCG iterates can

be recovered stably from the QMR process. Some further properties of the QMR approach are given and an error bound is presented. Finally, numerical experiments are reported. Author

**N91-32819*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**BEYOND FORMALISM**
Peter J. Denning 17 Jan. 1991 12 p
(Contract NCC2-387)
(NASA-CR-188886; NAS 1.26:188886; RIACS-TR-91-04) Avail: NTIS HC/MF A03 CSCL 09B

The ongoing debate over the role of formalism and formal specifications in software features many speakers with diverse positions. Yet, in the end, they share the conviction that the requirements of a software system can be unambiguously specified, that acceptable software is a product demonstrably meeting the specifications, and that the design process can be carried out with little interaction between designers and users once the specification has been agreed to. This conviction is part of a larger paradigm prevalent in American management thinking, which holds that organizations are systems that can be precisely specified and optimized. This paradigm, which traces historically to the works of Frederick Taylor in the early 1900s, is no longer sufficient for organizations and software systems today. In the domain of software, a new paradigm, called user-centered design, overcomes the limitations of pure formalism. Pioneered in Scandinavia, user-centered design is spreading through Europe and is beginning to make its way into the U.S. Author

**N91-32820*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**AN IMPLEMENTATION OF THE LOOK-AHEAD LANCZOS ALGORITHM FOR NON-HERMITIAN MATRICES**
Roland W. Freund, Martin H. Gutknecht, and Noel M. Nachtigal (Massachusetts Inst. of Tech., Cambridge.) Apr. 1991 26 p
(Contract NCC2-387)
(NASA-CR-188889; NAS 1.26:188889; RIACS-TR-91-09) Avail: NTIS HC/MF A03 CSCL 09B

The nonsymmetric Lanczos method can be used to compute eigenvalues of large sparse non-Hermitian matrices or to solve large sparse non-Hermitian linear systems. However, the original Lanczos algorithm is susceptible to possible breakdowns and potential instabilities. An implementation is presented of a look-ahead version of the Lanczos algorithm that, except for the very special situation of an incurable breakdown, overcomes these problems by skipping over those steps in which a breakdown or near-breakdown would occur in the standard process. The proposed algorithm can handle look-ahead steps of any length and requires the same number of matrix-vector products and inner products as the standard Lanczos process without look-ahead. Author

**N91-32821*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**KRYLOV SUBSPACE METHODS FOR COMPLEX NON-HERMITIAN LINEAR SYSTEMS**
Roland W. Freund (Wuerzburg Univ., Germany, F.R. ) May 1991 50 p
(Contract NCC2-387)
(NASA-CR-188891; NAS 1.26:188891; RIACS-TR-91-11) Avail: NTIS HC/MF A03 CSCL 09B

Krylov subspace methods are considered for the solution of large sparse linear systems $Ax = b$ with complex non-Hermitian coefficient matrices. Such linear systems arise in important applications, such an inverse scattering, numerical solution of time dependent Schroedinger equations, underwater acoustics, eddy current computations, numerical computations in quantum chromodynamics, and numerical conformal mapping. Typically the resulting coefficient matrices A exhibit special structures, such as complex symmetry, or they are shifted Hermitian matrices. A Krylov subspace approach is described with iterates defined by a quasi-minimal residual property, the QMR method, for solving general complex non-Hermitian linear systems. Then, special Krylov subspace methods designed for the two families of complex symmetric respectively shifted Hermitian linear systems. Some results are also included concerning the obvious approach to general complex linear systems by solving equivalent real linear systems for the real and imaginary parts of x. Finally, numerical experiments for linear systems arising from the complex Helmholtz equation are reported. Author

**N91-32822*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**MUTUAL EXCLUSION**
Peter J. Denning 21 Mar. 1991 15 p
(Contract NCC2-387)
(NASA-CR-188122; NAS 1.26:188122; RIACS-TR-91-13) Avail: NTIS HC/MF A03 CSCL 09B

Almost all computers today operate as part of a network, where they assist people in coordinating actions. Sometimes what appears to be a single computer is actually a network of cooperating computers; e.g., some supercomputers consist of many processors operating in parallel and exchanging synchronization signals. One of the most fundamental requirements in all these systems is that certain operations be indivisible: the steps of one must not be interleaved with the steps of another. Two approaches were designed to implement this requirement, one based on central locks and the other on distributed order tickets. Practicing scientists and engineers need to come to be familiar with these methods. Author

**N91-32823*#** Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
**USER DOCUMENTATION FOR THE MSK AND OMS INTELLIGENT TUTORING SYSTEMS**
Pamela K. Fink, L. Tandy Herren, and David T. Lincoln (Southwest Research Inst., San Antonio, TX.) 2 May 1991 33 p
(Contract NCC9-16; RICIS Proj. ET-23; SwRI Proj. 05-3515)
(NASA-CR-188815; NAS 1.26:188815) Avail: NTIS HC/MF A03 CSCL 09B

This user's guide describes how to use the Intelligent Tutoring Systems for the Manual Select Keyboard (MSK) and the Orbital Maneuvering System (OMS) and how to use the C code that runs the mockup version of the MSK. Author

**N91-32824*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**FEASIBILITY STUDY ON THE USE OF GROUPWARE SUPPORT FOR NASA SOURCE EVALUATION BOARDS Final Report**
Peter C. Bishop and Cissy Yoes (Houston Univ., Clear Lake, TX.) Jun. 1991 50 p
(Contract NCC9-16; RICIS Proj. IM-19)
(NASA-CR-188832; NAS 1.26:188832) Avail: NTIS HC/MF A03 CSCL 09B

Groupware is a class of computer based systems that support groups engaged in a common task (or goal) and that provide an interface to a shared environment. A potential application for groupware is the source evaluation board (SEB) process used in the procurement of government contracts. This study was undertaken to (1) identify parts of the SEB process which are candidates for groupware supports; and (2) identify tools which could be used to support the candidate process. Two processes of the SEB were identified as good candidates for groupware support: (1) document generation - a coordination and communication process required to present and document the findings of an SEB; and (2) group decision making - a highly analytical and integrative decision process requiring a clear and supportable outcome. Author

**N91-32825*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**PROGRAMMING IN A PROPOSED 9X DISTRIBUTED Ada Report No. 1**
Raymond S. Waldrop, Richard A. Volz, and Stephen J. Goldsack (Imperial Coll. of Science and Technology, London, England ) 10

Sep. 1990 8 p
(Contract NCC9-16; RICIS Proj. SE-35)
(NASA-CR-188831; NAS 1.26:188831) Avail: NTIS HC/MF A02 CSCL 09B

The proposed Ada 9X constructs for distribution was studied. The goal was to select suitable test cases to help in the evaluation of the proposed constructs. The examples were to be considered according to the following requirements: real time operation; fault tolerance at several different levels; demonstration of both distributed and massively parallel operation; reflection of realistic NASA programs; illustration of the issues of configuration, compilation, linking, and loading; indications of the consequences of using the proposed revisions for large scale programs; and coverage of the spectrum of communication patterns such as predictable, bursty, small and large messages. The first month was spent identifying possible examples and judging their suitability for the project. Author

**N91-32826*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**MACHINE LEARNING RESEARCH 1989-90 Final Report**
Bruce W. Porter and Arthur Souther (Texas Univ., Austin.) 1 Jun. 1990 27 p
(Contract NCC9-16; RICIS Proj. ET-14)
(NASA-CR-188828; NAS 1.26:188828) Avail: NTIS HC/MF A03 CSCL 09B

Multifunctional knowledge bases offer a significant advance in artificial intelligence because they can support numerous expert tasks within a domain. As a result they amortize the costs of building a knowledge base over multiple expert systems and they reduce the brittleness of each system. Due to the inevitable size and complexity of multifunctional knowledge bases, their construction and maintenance require knowledge engineering and acquisition tools that can automatically identify interactions between new and existing knowledge. Furthermore, their use requires software for accessing those portions of the knowledge base that coherently answer questions. Considerable progress was made in developing software for building and accessing multifunctional knowledge bases. A language was developed for representing knowledge, along with software tools for editing and displaying knowledge, a machine learning program for integrating new information into existing knowledge, and a question answering system for accessing the knowledge base. Author

**N91-32827*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**AN INTELLIGENT TUTORING SYSTEM FOR THE INVESTIGATION OF HIGH PERFORMANCE SKILL ACQUISITION**
Pamela K. Fink, L. Tandy Herren, and J. Wesley Regian (Air Force Human Resources Lab., Brooks AFB, TX.) May 1991 33 p
(Contract NCC9-16; RICIS Proj. ET-23)
(NASA-CR-188827; NAS 1.26:188827) Avail: NTIS HC/MF A03 CSCL 09B

The issue of training high performance skills is of increasing concern. These skills include tasks such as driving a car, playing the piano, and flying an aircraft. Traditionally, the training of high performance skills has been accomplished through the use of expensive, high-fidelity, 3-D simulators, and/or on-the-job training using the actual equipment. Such an approach to training is quite expensive. The design, implementation, and deployment of an intelligent tutoring system developed for the purpose of studying the effectiveness of skill acquisition using lower-cost, lower-physical-fidelity, 2-D simulation. Preliminary experimental results are quite encouraging, indicating that intelligent tutoring systems are a cost-effective means of training high performance skills. Author

**N91-32828*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**ADVANCED SOFTWARE DEVELOPMENT WORKSTATION PROJECT, PHASE 3 Final Report**
15 Feb. 1991 34 p Prepared in cooperation with Inference Corp., El Segundo, CA
(Contract NCC9-16; RICIS Proj. SE-25)
(NASA-CR-188824; NAS 1.26:188824) Avail: NTIS HC/MF A03 CSCL 09B

ACCESS provides a generic capability to develop software information system applications which are explicitly intended to facilitate software reuse. In addition, it provides the capability to retrofit existing large applications with a user friendly front end for preparation of input streams in a way that will reduce required training time, improve the productivity even of experienced users, and increase accuracy. Current and past work shows that ACCESS will be scalable to much larger object bases. Author

**N91-32829*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**ADVANCED SOFTWARE DEVELOPMENT WORKSTATION PROJECT ACCESS USER'S GUIDE**
Oct. 1990 36 p Prepared in cooperation with Inference Corp., El Segundo, CA
(Contract NCC9-16; RICIS Proj. SE-25)
(NASA-CR-188823; NAS 1.26:188823) Avail: NTIS HC/MF A03 CSCL 09B

ACCESS is a knowledge based software information system designed to assist the user in modifying retrieved software to satisfy user specifications. A user's guide is presented for the knowledge engineer who wishes to create for ACCESS a knowledge base consisting of representations of objects in some software system. This knowledge is accessible to an end user who wishes to use the catalogued software objects to create a new application program or an input stream for an existing system. The application specific portion of an ACCESS knowledge base consists of a taxonomy of object classes, as well as instances of these classes. All objects in the knowledge base are stored in an associative memory. ACCESS provides a standard interface for the end user to browse and modify objects. In addition, the interface can be customized by the addition of application specific data entry forms and by specification of display order for the taxonomy and object attributes. These customization options are described. Author

**N91-32830*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**RESEARCH INTO THE INTERACTION BETWEEN HIGH PERFORMANCE AND COGNITIVE SKILLS IN AN INTELLIGENT TUTORING SYSTEM Final Report**
Pamela K. Fink (Southwest Research Inst., San Antonio, TX.) 31 May 1991 26 p
(Contract NCC9-16; RICIS Proj. ET-23; SwRI Proj. 05-3515)
(NASA-CR-188821; NAS 1.26:188821) Avail: NTIS HC/MF A03 CSCL 09B

Two intelligent tutoring systems were developed. These tutoring systems are being used to study the effectiveness of intelligent tutoring systems in training high performance tasks and the interrelationship of high performance and cognitive tasks. The two tutoring systems, referred to as the Console Operations Tutors, were built using the same basic approach to the design of an intelligent tutoring system. This design approach allowed researchers to more rapidly implement the cognitively based tutor, the OMS Leak Detect Tutor, by using the foundation of code generated in the development of the high performance based tutor, the Manual Select Keyboard (MSK). It is believed that the approach can be further generalized to develop a generic intelligent tutoring system implementation tool. Author

**N91-32831#** National Weather Service, Salt Lake City, UT.
**CLINEWS: NOAA WESTERN REGION COMPUTER PROGRAMS AND PROBLEMS**
R. Stuyvesant May 1991 28 p
(PB91-200709; NOAA-NWS-WRCP-62) Avail: NTIS HC/MF A03 CSCL 09B

Daily climatological data are currently being compiled at most National Weather Service Offices. Many of these offices provide the information to the media. The computer program CLINEWS was created to minimize the effort required to compile the data. It

creates an AFOS product ready for dissemination to the media. Site-specific information can be added by editing the finished product, if needed. A by-product of the program is a set of AFOS database products (created during initial set-up using a preformat and maintained by the program) that may be used by other applications programs or as a reference for inquiries. Other than the initial creating of the preformats during set-up and the addition of any site-specific information, no manual intervention is necessary. GRA

**N91-32832#** Department of Transportation, Cambridge, MA.
**VEHICLE ANIMATION SOFTWARE (VAS) TO ANIMATE RESULTS OBTAINED FROM VEHICLE HANDLING AND ROLLOVER SIMULATIONS AND TESTS Final Reportl, Aug. 1989 - May 1990**
Andrzej G. Nalecz Apr. 1991 340 p
(Contract DTRS57-89-P-82291)
(PB91-194142; DOT-HS-807688; DOT-TSC-NHTSA-90-2) Avail: NTIS HC/MF A15 CSCL 09B

The development and application of the Vehicle Animation Software (VAS) capable of animating the results from vehicle handling and rollover simulations and experimental tests are described. The computer simulations which can currently be animated using VAS include the Intermediate Maneuver Induced Rollover Simulation (IMIRS), the Intermediate Tripped Rollover Simulation (ITRS), and the Advanced Vehicle Rollover Model (AVRM) developed for the National Highway Traffic Safety Administration (NHTSA). The user's manual and technical report are included, and the required format for experimental data files which are to be animated are explained. GRA

**N91-32833#** Argonne National Lab., IL.
**PERFORMANCE OF A BENCHMARK IMPLEMENTATION OF THE VAN SLYKE AND WETS ALGORITHM FOR STOCHASTIC PROGRAMS ON THE ALLIANT FX/8**
K. A. Ariyawansa Apr. 1991 13 p Presented at the 5th Society for Industrial and Applied Mathematics (SIAM) Conference, Houston, TX, 22-29 Mar. 1991
(Contracts DE-FG06-87ER-25045; W-31-109-eng-38)
(DE91-016515; ANL/CP-73599; CONF-910326-6) Avail: NTIS HC/MF A03

A benchmark parallel implementation of the Van Slyke and Wets algorithm for stochastic linear programs, and the results of a carefully designed numerical experiment on the Sequent/Balance using the implementation are presented. An important use of this implementation is as a benchmark to assess the performance of approximation algorithms for stochastic linear programs. These approximation algorithms are best suited for implementation on parallel vector processes like the Alliant FX/8. Therefore, the performance of the benchmark implementation on the Alliant FX/8 is of interest. In this paper, we present results observed when a portion of the numerical experiment is performed on the Alliant FX/8. These results indicate that the implementation makes satisfactory use of the concurrency capabilities of the Alliant FX/8. They also indicate that the vectorization capabilities of the Alliant FX/8 are not satisfactorily utilized by the implementation. DOE

**N91-32834#** Oak Ridge National Lab., TN.
**PARALLEL IMPLEMENTATION OF A NONSYMMETRIC TRIDIAGONAL EIGENSOLVER**
G. A. Geist and E. R. Jessup 1991 6 p Presented at the 5th Society for Industrial and Applied Mathematics (SIAM) Conference, Houston, TX, 22-29 Mar. 1991
(Contract DE-AC05-84OR-21400)
(DE91-016773; CONF-910326-7) Avail: NTIS HC/MF A02

In this paper, we investigate parallel solution of the nonsymmetric tridiagonal eigenproblem by the LR (local relaxation) method, inverse iteration, and Rayleigh quotient iteration on a distributed-memory computer. We examine serial computation of eigenvalues followed by parallel computation of block- or wrap-distributed eigenvectors and parallel computation of eigenvalues using a block algorithm. We also consider pipelining the calculation of eigenvalues with the calculation of the eigenvectors. Experiments on an Intel iPSC/860, where the communication to computation ratio is very large, show that serial eigenvalue computation with wrap-mapped eigenvector computation has the lowest execution time. DOE

**N91-32835#** California Univ., Berkeley. Lawrence Berkeley Lab.
**ANALYSIS OF POLARIZATION PROPERTIES OF SHALLOW METALLIC GRATINGS BY AN EXTENDED RAYLEIGH-FANO THEORY**
Masato Koike and Takeshi Namioka (Tohoku Univ., Sendal, Japan) Jun. 1991 7 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract DE-AC03-76SF-00098)
(DE91-016982; LBL-30889; CONF-9107115-27) Avail: NTIS HC/MF A02

Rayleigh-Fano theory has been extended for the purpose of calculating the polarization anomaly of a grating having shallow grooves and finite conductivity. Simple analytic formulas are derived for predicting the position and the appearance of the anomalies. Phenomenological explanations are given to the origin of the anomalies. The validity of our analysis is examined by comparing computed degree of polarization with experimental data obtained in the visible region for Al-, Ag-, and Au-coated blazed gratings. DOE

**N91-32836*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**G/SPLINES: A HYBRID OF FRIEDMAN'S MULTIVARIATE ADAPTIVE REGRESSION SPLINES (MARS) ALGORITHM WITH HOLLAND'S GENETIC ALGORITHM**
David Rogers May 1991 9 p Submitted for publication
(Contracts NCC2-387; NCC2-408)
(NASA-CR-188935; NAS 1.26:188935; RIACS-TR-91-10) Avail: NTIS HC/MF A02 CSCL 09B

G/SPLINES are a hybrid of Friedman's Multivariable Adaptive Regression Splines (MARS) algorithm with Holland's Genetic Algorithm. In this hybrid, the incremental search is replaced by a genetic search. The G/SPLINE algorithm exhibits performance comparable to that of the MARS algorithm, requires fewer least squares computations, and allows significantly larger problems to be considered. Author

**N91-32837*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**ART-Ada: AN Ada-BASED EXPERT SYSTEM TOOL**
S. Daniel Lee and Bradley P. Allen (Inference Corp., El Segundo, CA.) Jun. 1990 12 p Previously announced in IAA as N91-20698 Submitted for publication
(Contract NCC9-16; RICIS Proj. SE-19)
(NASA-CR-188930; NAS 1.26:188930) Avail: NTIS HC/MF A03 CSCL 09B

The Department of Defense mandate to standardize on Ada as the language for software systems development has resulted in an increased interest in making expert systems technology readily available in Ada environments. NASA's Space Station Freedom is an example of the large Ada software development projects that will require expert systems in the 1990's. Another large scale application that can benefit from Ada based expert system tool technology is the Pilot's Associate (PA) expert system project for military combat aircraft. The Automated Reasoning Tool-Ada (ART-Ada), an Ada expert system tool, is explained. ART-Ada allows applications of a C-based expert system tool called ART-IM to be deployed in various Ada environments. ART-Ada is being used to implement several prototype expert systems for NASA's Space Station Freedom program and the U.S. Air Force. Author

**N91-32838*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**Ada ISSUES IN IMPLEMENTING ART-Ada**
S. Daniel Lee (Inference Corp., El Segundo, CA.) Nov. 1990 18 p Presented at the 3d Annual NASA Ada User's Symposium,

Houston, TX, Nov. 1990
(Contract NCC9-16; RICIS Proj. SE-19)
(NASA-CR-188941; NAS 1.26:188941) Avail: NTIS HC/MF A03 CSCL 09B

Due to the Ada mandate of a number of government agencies, interest in deploying expert systems such as Ada has increased. Recently, several Ada-based expert system tools have been developed. According to a recent benchmark report, these tools do not perform as well as similar tools written in C. While poorly implemented Ada compilers contribute to the poor benchmark result, some fundamental problems of the Ada language itself have been uncovered. Here, the authors describe Ada language issues encountered during the deployment of ART-Ada, an expert system tool for Ada deployment. ART-Ada is being used to implement several prototype expert systems for the Space Station Freedom and the U.S. Air Force. Author

**N91-32839*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**TOWARD THE EFFICIENT IMPLEMENTATION OF EXPERT SYSTEMS IN Ada**
S. Daniel Lee (Inference Corp., El Segundo, CA.) Dec. 1990 15 p Submitted for publication
(Contract NCC9-16; RICIS Proj. SE-19)
(NASA-CR-188942; NAS 1.26:188942) Avail: NTIS HC/MF A03 CSCL 09B

Here, the authors describe Ada language issues encountered during the development of ART-Ada, an expert system tool for Ada deployment. ART-Ada is being used to implement several expert system applications for the Space Station Freedom and the U.S. Air Force. Additional information is given on dynamic memory allocation. Author

**N91-32840** Massachusetts Inst. of Tech., Cambridge. Center for Computational Research in Economics and Management Science.
**LEARNING-LOGIC: CASTING THE CORTEX OF THE HUMAN BRAIN IN SILICON**
David B. Parker Feb. 1985 51 p
(NASA Order C-60376-P)
(MIT-TR-47) Copyright Avail: Issuing Activity

Learning-Logic (LL) is two things: (1) a model of the neurons in the human cortex, and (2) a practical way to create electronic circuits that can learn and think. As a model of human brains, LL can explain why there are two types of neurons in cortex (the pyramidal and stellate neurons) and can describe mathematically how each type works. As part of this, LL can explain how long term memory works. These explanations can be verified experimentally because LL makes several specific predictions about the behavior of the pyramidal and stellate neurons. By being able to identify the significance of various neural features to learning and thinking, LL may be of help in the search for cures to certain types of learning disorders. As a practical invention, LL is believed to enable the bypassing of the 5th generation of computers and moving directly to the 6th - to computers which require no programming at all and which have the same capabilities as the human mind. LL cells, which correspond to the neurons of human brains, can be simulated in software that runs on standard computers or can be created directly on integrated circuit chips. Author

**N91-32841*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**GIGAFLOP PERFORMANCE ON A CRAY-2: MULTITASKING A COMPUTATIONAL FLUID DYNAMICS APPLICATION**
Geoffrey M. Tennille, Andrea L. Overman, Jules J. Lambiotte, and Craig L. Streett Oct. 1991 19 p
(NASA-TM-4305; L-16932; NAS 1.15:4305) Avail: NTIS HC/MF A03 CSCL 09B

The methodology is described for converting a large, long-running applications code that executed on a single processor of a CRAY-2 supercomputer to a version that executed efficiently on multiple processors. Although the conversion of every application is different, a discussion of the types of modification used to achieve gigaflop performance is included to assist others in the parallelization of applications for CRAY computers, especially those that were developed for other computers. An existing application, from the discipline of computational fluid dynamics, that had utilized over 2000 hrs of CPU time on CRAY-2 during the previous year was chosen as a test case to study the effectiveness of multitasking on a CRAY-2. The nature of dominant calculations within the application indicated that a sustained computational rate of 1 billion floating-point operations per second, or 1 gigaflop, might be achieved. The code was first analyzed and modified for optimal performance on a single processor in a batch environment. After optimal performance on a single CPU was achieved, the code was modified to use multiple processors in a dedicated environment. The results of these two efforts were merged into a single code that had a sustained computational rate of over 1 gigaflop on a CRAY-2. Timings and analysis of performance are given for both single- and multiple-processor runs. Author

**N91-32842#** Oak Ridge National Lab., TN.
**GOOSE: A GENERALIZED OBJECT-ORIENTED SIMULATION ENVIRONMENT**
C. E. Ford, C. March-Leuba, L. Guimaraes, and D. Ugolini (Tennessee Univ., Knoxville.) 1991 7 p Presented at the 1991 Simulation Technology International Conference, Orlando, FL, 21-23 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE91-016771; CONF-9110173-1) Avail: NTIS HC/MF A02

The GOOSE, a prototype software for a fully interactive, object-oriented simulation environment, is being developed as part of the Advanced Controls Program at Oak Ridge National Laboratory. Dynamic models may easily be constructed and tested; fully interactive capabilities allow the user to alter model parameters and complexity without recompilation. This environment provides access to powerful tools, such as numerical integration packages, graphical displays, and online help. Portability has been an important design goal; the system was written in Objective-C in order to run on a wide variety of computers and operating systems, including UNIX workstations and personal computers. A detailed library of nuclear reactor components, currently under development, will also be described. DOE

**N91-32843#** Sandia National Labs., Albuquerque, NM.
**USER'S MANUAL FOR PANDA 2: A COMPUTER CODE FOR CALCULATING EQUATIONS OF STATE**
G. I. Kerley 18 Jul. 1991 176 p
(Contract DE-AC04-76DP-00789)
(DE91-017717; SAND-88-2291) Avail: NTIS HC/MF A09

PANDA is an interactive computer code that is used to compute equations of state (EOS) for many classes of materials over a wide range of densities and temperatures. The first step in the development of a general EOS model is to determine the EOS for a one-component system, consisting of a single solid or fluid phase and a single chemical species. The results of several such calculations can then be combined to construct EOS for multiphase and multicomponent systems. For one-component solids and fluids, PANDA offers a variety of options for modeling various contributions to the EOS: the zero Kelvin isotherm, lattice vibrations, fluid degrees of freedom, thermal electronic excitation and ionization, and molecular vibrational and rotational degrees of freedom. Two options are available for computing EOS for multicomponent systems from separate EOS for the individual species and phases. The phase transition model is used for a system of immiscible phases, each having the same chemical composition. In the mixture model, the components can be either miscible or immiscible and can have different chemical compositions; mixtures can be either inert or reactive. PANDA provides over 50 commands that are used to define the EOS models, to make calculations and compare the models to experimental data, and to generate and maintain tabular EOS libraries for use in hydrocodes and other applications. Versions of the code available for the Cray (UNICOS and CTSS), SUN (UNIX), and VAX(VMS) machines, and a small version is

available for personal computers (DOS). This report describes the EOS models, use of the commands, and several sample problems. DOE

**N91-32844*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**AUTOMATIC BLOCKING OF NESTED LOOPS**
Robert Schreiber and Jack J. Dongarra (Tennessee Univ., Knoxville.) Aug. 1990 44 p Prepared in cooperation with Oak Ridge National Lab., TN Submitted for publication
(Contracts NCC2-387; DE-AC0S-84OR-21400)
(NASA-CR-188874; NAS 1.26:188874; RIACS-TR-90-38) Avail: NTIS HC/MF A03 CSCL 09B

Blocked algorithms have much better properties of data locality and therefore can be much more efficient than ordinary algorithms when a memory hierarchy is involved. On the other hand, they are very difficult to write and to tune for particular machines. The reorganization is considered of nested loops through the use of known program transformations in order to create blocked algorithms automatically. The program transformations used are strip mining, loop interchange, and a variant of loop skewing in which invertible linear transformations (with integer coordinates) of the loop indices are allowed. Some problems are solved concerning the optimal application of these transformations. It is shown, in a very general setting, how to choose a nearly optimal set of transformed indices. It is then shown, in one particular but rather frequently occurring situation, how to choose an optimal set of block sizes. Author

**N91-32042#** Institute of Computational Fluid Dynamics, Tokyo (Japan).
**SURFACE GRID GENERATION BASED ON UNSTRUCTURED GRID**
Masahiro Suzuki *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 77-82 In JAPANESE; ENGLISH summary Previously announced in IAA as A90-45931 (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32669*#** Alabama Univ., Huntsville.
**ADVANCED VISUALIZATION TECHNIQUES**
Mike Botts *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 25-27 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 09B

**N91-33028*#** Illinois Univ., Urbana-Champaign.
**COMPUTING AND DATA PROCESSING**
Larry Smarr, William Press, David W. Arnett, Alastair G. W. Cameron, Richard M. Crutcher, David J. Helfand, Paul Horowitz, Susan G. Kleinmann, Jeffrey L. Linsky, and Barry F. Madore (California Inst. of Tech., Pasadena.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 25 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 09B

# 62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

**N91-32845*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**MULTILEVEL FILTERING ELLIPTIC PRECONDITIONERS**
C. C. Jay Kuo, Tony F. Chan, and Charles Tong (California Univ., Los Angeles.) Aug. 1989 49 p Presented at the SIAM Symposium on Sparse Matrices, Gleneden Beach, OR, 22-24 May 1989
(Contracts NCC2-387; DAAL03-88-K-0085; NSF DMS-87-14612) (NASA-CR-188851; NAS 1.26:188851; RIACS-TR-89-36) Avail: NTIS HC/MF A03 CSCL 09B

A class of preconditioners is presented for elliptic problems built on ideas borrowed from the digital filtering theory and implemented on a multilevel grid structure. They are designed to be both rapidly convergent and highly parallelizable. The digital filtering viewpoint allows the use of filter design techniques for constructing elliptic preconditioners and also provides an alternative framework for understanding several other recently proposed multilevel preconditioners. Numerical results are presented to assess the convergence behavior of the new methods and to compare them with other preconditioners of multilevel type, including the usual multigrid method as preconditioner, the hierarchical basis method and a recent method proposed by Bramble-Pasciak-Xu. Author

**N91-32846*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**COLLABORATION TECHNOLOGY AND SPACE SCIENCE**
Barry M. Leiner, R. L. Brown, and R. F. Haines Jul. 1990 13 p Presented at the 41st Congress of the International Astronautical Federation, Oct. 1990 Previously announced in IAA as A91-13736 Submitted for publication
(Contract NCC2-387)
(NASA-CR-188861; NAS 1.26:188861; RIACS-TR-90-25) Avail: NTIS HC/MF A03 CSCL 09B

A summary of available collaboration technologies and their applications to space science is presented as well as investigations into remote coaching paradigms and the role of a specific collaboration tool for distributed task coordination in supporting such teleoperations. The applicability and effectiveness of different communication media and tools in supporting remote coaching are investigated. One investigation concerns a distributed check-list, a computer-based tool that allows a group of people, e.g., onboard crew, ground based investigator, and mission control, to synchronize their actions while providing full flexibility for the flight crew to set the pace and remain on their operational schedule. This autonomy is shown to contribute to morale and productivity. Author

**N91-32847*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**HIGHLY PARALLEL SPARSE CHOLESKY FACTORIZATION**
John R. Gilbert (Xerox Palo Alto Research Center, CA.) and Robert Schreiber Aug. 1990 45 p Submitted for publication
(Contract NCC2-387)
(NASA-CR-188875; NAS 1.26:188875; RIACS-TR-90-39) Avail: NTIS HC/MF A03 CSCL 09B

Several fine grained parallel algorithms were developed and compared to compute the Cholesky factorization of a sparse matrix. The experimental implementations are on the Connection Machine, a distributed memory SIMD machine whose programming model conceptually supplies one processor per data element. In contrast to special purpose algorithms in which the matrix structure conforms to the connection structure of the machine, the focus is on matrices with arbitrary sparsity structure. The most promising algorithm is one whose inner loop performs several dense factorizations simultaneously on a 2-D grid of processors. Virtually any massively parallel dense factorization algorithm can be used as the key subroutine. The sparse code attains execution rates comparable to those of the dense subroutine. Although at present architectural limitations prevent the dense factorization from realizing its potential efficiency, it is concluded that a regular data parallel architecture can be used efficiently to solve arbitrarily structured sparse problems. A performance model is also presented and it is used to analyze the algorithms. Author

**N91-32848*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**A BICONJUGATE GRADIENT TYPE ALGORITHM ON MASSIVELY PARALLEL ARCHITECTURES**
Roland W. Freund and Marlis Hochbruck (Karlsruhe Univ., Germany, F.R. ) Mar. 1991 107 p

(Contract NCC2-387)
(NASA-CR-188888; NAS 1.26:188888; RIACS-TR-91-07) Avail: NTIS HC/MF A06 CSCL 09B

The biconjugate gradient (BCG) method is the natural generalization of the classical conjugate gradient algorithm for Hermitian positive definite matrices to general non-Hermitian linear systems. Unfortunately, the original BCG algorithm is susceptible to possible breakdowns and numerical instabilities. Recently, Freund and Nachtigal have proposed a novel BCG type approach, the quasi-minimal residual method (QMR), which overcomes the problems of BCG. Here, an implementation is presented of QMR based on an s-step version of the nonsymmetric look-ahead Lanczos algorithm. The main feature of the s-step Lanczos algorithm is that, in general, all inner products, except for one, can be computed in parallel at the end of each block; this is unlike the other standard Lanczos process where inner products are generated sequentially. The resulting implementation of QMR is particularly attractive on massively parallel SIMD architectures, such as the Connection Machine. Author

**N91-32849#** Fermi National Accelerator Lab., Batavia, IL.
**FUTURE PROSPECTS FOR NETWORKING IN THE UNITED STATES**
W. Lidinsky Mar. 1991 14 p Presented at the Conference on Computing in High Energy Physics, Tsukuba, Japan, 11-15 Mar. 1991
(Contract DE-AC02-76CH-03000)
(DE91-017359; FNAL/C-91/90; CONF-910373-15) Avail: NTIS HC/MF A03

When considering networks on the basis of geographical scope (i.e., local to wide area networks), the focus is often on the lower three layers of the International Standards Organization Open Systems Interconnection Reference Model (OSI/RM). By contrast, the upper three layers of the Model deal not so much with transport as with network services that are to a first approximation independent of geographical scope. Using this theme, the paper first discusses United States trends in local, metropolitan, and wide area networks. Following this is a description of computer services needed and advances in services offered by networks; an area of increasing emphasis in the United States. Finally, consideration is given to the impact that such trends may have on high energy physics and U.S. HEPnet. The time horizon considered here is limited to mid-decade or a little beyond because studies of technology forecasting beyond five to six years have been shown to be inaccurate. This paper concentrates on computer networks. Through the mid-1990's there appears to be no significant technical or cost advantage for integrating voice and data. DOE

**N91-32850*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
**A NASA/RAE COOPERATION IN THE DEVELOPMENT OF A REAL-TIME KNOWLEDGE-BASED AUTOPILOT**
Colin Daysh, Malcolm Corbin, Geoff Butler, Eugene L. Duke, Steven D. Belle, and Randal W. Brumbaugh (PRC Kentron, Inc., Edwards, CA.) Aug. 1991 15 p Presented at the Avionics Panel Symposium, Lisbon, Portugal, May 1991
(NASA-TM-104234; H-1727; NAS 1.15:104234) Avail: NTIS HC/MF A03 CSCL 09B

As part of a US/UK cooperative aeronautical research program, a joint activity between the NASA Dryden Flight Research Facility and the Royal Aerospace Establishment on knowledge-based systems was established. This joint activity is concerned with tools and techniques for the implementation and validation of real-time knowledge-based systems. The proposed next stage of this research is described, in which some of the problems of implementing and validating a knowledge-based autopilot for a generic high-performance aircraft are investigated. Author

**N91-32851*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.
**FROM AN AUTOMATED FLIGHT-TEST MANAGEMENT SYSTEM TO A FLIGHT-TEST ENGINEER'S WORKSTATION**
E. L. Duke, Randal W. Brumbaugh, M. D. Hewett, and D. M. Tartt (G and C Systems, Inc., San Juan Capistrano, CA.) Oct. 1991 16 p Presented at the Guidance and Control Panel's 53d Symposium: Air Vehicle Mission Control and Management, Amsterdam, Netherlands, 22-26 Oct. 1991
(NASA-TM-104242; H-1761; NAS 1.15:104242; AGARD-29)
Avail: NTIS HC/MF A03 CSCL 09B

The capabilities and evolution is described of a flight engineer's workstation (called TEST-PLAN) from an automated flight test management system. The concept and capabilities of the automated flight test management systems are explored and discussed to illustrate the value of advanced system prototyping and evolutionary software development. Author

**N91-32852*** National Aeronautics and Space Administration. Pasadena Office, CA.
**ANALOG HARDWARE FOR LEARNING NEURAL NETWORKS**
**Patent**
Silvio P. Eberhardt, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 8 Oct. 1991 11 p Filed 28 Dec. 1989 Supersedes N90-27384 (30 - 21, p 3057)
(NASA-Case-NPO-17664-1-CU; US-Patent-5,056,037;
US-Patent-Appl-SN-463720; US-Patent-Class-364-513;
US-Patent-Class-364-807; Int-Patent-Class-G06G-7/12) Avail: US Patent and Trademark Office CSCL 09B

This is a recurrent or feedforward analog neural network processor having a multi-level neuron array and a synaptic matrix for storing weighted analog values of synaptic connection strengths which is characterized by temporarily changing one connection strength at a time to determine its effect on system output relative to the desired target. That connection strength is then adjusted based on the effect, whereby the processor is taught the correct response to training examples connection by connection.
Official Gazette of the U.S. Patent and Trademark Office

**N91-32853*#** California Univ., Davis.
**THE FORMAL VERIFICATION OF GENERIC INTERPRETERS**
**Final Report**
P. Windley, K. Levitt, and G. C. Cohen (Boeing Military Airplane Development, Seattle, WA.) Washington NASA Oct. 1991 203 p
(Contract NAS1-18586)
(NASA-CR-4403; NAS 1.26:4403) Avail: NTIS HC/MF A10 CSCL 09B

The task assignment 3 of the design and validation of digital flight control systems suitable for fly-by-wire applications is studied. Task 3 is associated with formal verification of embedded systems. In particular, results are presented that provide a methodological approach to microprocessor verification. A hierarchical decomposition strategy for specifying microprocessors is also presented. A theory of generic interpreters is presented that can be used to model microprocessor behavior. The generic interpreter theory abstracts away the details of instruction functionality, leaving a general model of what an interpreter does. Author

**N91-32854#** Argonne National Lab., IL.
**PARALLEL COMPUTING AND DOMAIN DECOMPOSITION**
W. Gropp 1991 13 p Presented at the 5th Conference on Domain Deconposition Methods for Partial Differential Equations, Norfolk, VA, 6-8 May 1991
(Contract W-31-109-eng-38)
(DE91-017967; ANL/CP-73910; CONF-9105217-2) Avail: NTIS HC/MF A03

Domain decomposition techniques appear a natural way to make good use of parallel computers. In particular, these techniques divide a computation into a local part, which may be done without any interprocessor communication, and a part that involves communication between neighboring and distant processors. This paper discusses some of the issues in designing and implementing a parallel domain decomposition algorithm. A framework for evaluating the cost of parallelism is introduced and applied to answering questions such as which and how many processors should solve global problems and what impact load balancing has

on the choice of domain decomposition algorithm. The sources of performance bottlenecks are discussed. This analysis suggests that domain decomposition techniques will be effective on high-performance parallel processors and on networks of workstations. DOE

**N91-32855#** Los Alamos National Lab., NM.
**PRESENT AND FUTURE SUPERCOMPUTER NETWORK ARCHITECTURES**
D. E. Tolmie 1991 10 p Presented at the SPIE Meeting, Boston, MA, 3-6 Sep. 1991
(Contract W-7405-eng-36)
(DE91-018035; LA-UR-91-2705; CONF-9109230-3) Avail: NTIS HC/MF A02

Computer networks must provide high data transfer rates to maximize the effectiveness of the interconnected equipment, and especially to maximize the effectiveness of the users, e.g., with visualization. Network speeds are increasing, with the newest systems using 800 Mbit/s data rates. The most common computer networks today use bus and ring architectures. Supercomputer networks are starting to use circuit switching with crossbar switches. Wavelength division multiplexing and all optical networking are research topics today, but hold promise for the future. The architectures, attributes, and problems of these different systems are discussed, with emphasis on their use in the supercomputer environment. DOE

**N91-32856#** Los Alamos National Lab., NM.
**WHAT'S HAPPENING WITH SUPERCOMPUTER NETWORKS?**
D. E. Tolmie 1991 8 p Presented at the 24th Network Systems Users Group Annual Conference, Scottsdale, AZ, 25 Sep. 1991
(Contract W-7405-eng-36)
(DE91-018036; LA-UR-91-2704; CONF-9109248-1) Avail: NTIS HC/MF A02

Computer networks must become faster as the equipment that is being interconnected increases in power and performance. Ethernet, with a 10 Mbit/s speed, seemed awesome a few years ago, but is beginning to show its age as more machines are tied together, and workstations attain the power of yesterdays mainframes. Networks using gigabit speeds are just starting to become available and offer a whole new set of problems and potential. The networks proposed for supercomputers today will be the run-of-the-mill networks interconnecting workstations and other ADP equipment in the near future. This paper addresses what the higher speeds are being used for, the standards efforts specifying the higher speed channels, the network architectures being proposed, and some of the open problems requiring extensive further work. DOE

**N91-32037#** Tokyo Metropolitan Univ. (Japan). Dept. of Mechanical Engineering.
**ON THE PARALLEL PROCESSING OF DIRECT SIMULATION MONTE CARLO METHOD**
Masahiro Ota and Tetsuya Tanaka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 39-44 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

# 63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

**N91-32857#** Naval Weapons Center, China Lake, CA.
**EQUATIONS OF LEARNING AND CAPACITY OF LAYERED NEURAL NETWORKS Final Report, Oct. 1987 - May 1989**
Jorge M. Martin May 1989 35 p
(AD-A229633; AD-E900925; NWC-TP-7013) Avail: NTIS HC/MF A03 CSCL 12/5

Learning in a layered neural network (LNN) amounts to finding the correct interconnection weights that will produce the right input-output pairs. The input-output pairs and the architecture of the net, define equations that the weights must satisfy. These equations, the Equations of Learning, are derived. By applying well known results from dimension theory to these equations, one can derive an upper bound on the number of different input-output pairs that a layered network can learn. Two simple examples are used to illustrate this result and its limitations. While analyzing the first example, it was discovered that the saturation of the sigmoid function is a desirable feature. The concepts of architecture and capacity of an LNN are defined, and a few results on architecture with maximal capacity are included. It was found that reducing the dimension of the output patterns increases the capacity of the LNN. Author

**N91-32858#** Sandia National Labs., Albuquerque, NM.
**MILITARY ROBOTICS TECHNOLOGIES AT SANDIA NATIONAL LABORATORIES**
R. H. Byrne and P. R. Klarer 1991 16 p Presented at the 3rd Conference on Military Robotic Applications, Alberta, 9-12 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016113; SAND-91-0633C; CONF-9109227-1) Avail: NTIS HC/MF A03

Sandia National Laboratories' Advanced Technologies Division has been developing mobile robotics technologies for the U.S. Department of Energy and the U.S. Department of Defense since 1984. The systems developed at Sandia over the past several years which have high potential for military applications are described in this paper. Those applications include reconnaissance, antiarmor, NBC detection, hazardous inspection duty, and physical security. The cooperation of multiple vehicles has also been demonstrated at Sandia, and the military applications of this capability are reviewed. The technical approach taken with all of the systems described use a low-cost/low-complexity philosophy, which has translated into very reliable systems. Although several levels of autonomy have been demonstrated by researchers in recent years, the most mature technology for military applications continues to be teleoperation and telemanagement. Telemanagement is a mix of teleoperation and autonomous operations which relies on human interaction with semi-autonomous systems to combine the benefits of human perception and decision-making with the lower operator workloads associated with autonomous systems. DOE

**N91-32859*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**DISTRIBUTED MEMORY APPROACHES FOR ROBOTIC NEURAL CONTROLLERS**
Charles C. Jorgensen Aug. 1990 71 p Sponsored in part by USRA
(Contract NCC2-387)
(NASA-CR-188865; NAS 1.26:188865; RIACS-TR-90-29) Avail: NTIS HC/MF A04 CSCL 09B

The suitability is explored of two varieties of distributed memory neutral networks as trainable controllers for a simulated robotics task. The task requires that two cameras observe an arbitrary target point in space. Coordinates of the target on the camera image planes are passed to a neural controller which must learn to solve the inverse kinematics of a manipulator with one revolute and two prismatic joints. Two new network designs are evaluated. The first, radial basis sparse distributed memory (RBSDM), approximates functional mappings as sums of multivariate gaussians centered around previously learned patterns. The second network types involved variations of Adaptive Vector Quantizers or Self Organizing Maps. In these networks, random N dimensional points are given local connectivities. They are then exposed to training patterns and readjust their locations based on a nearest neighbor rule. Both approaches are tested based on their ability to interpolate manipulator joint coordinates for simulated arm

movement while simultaneously performing stereo fusion of the camera data. Comparisons are made with classical k-nearest neighbor pattern recognition techniques. Author

**N91-32860#** Argonne National Lab., IL. Environmental Assessment and Information Sciences Div.
**EVALUATION OF KNOWLEDGE-BASED SYSTEM DEVELOPMENT TOOLS**
M. K. Duffy, C. M. Macal, J. P. Peerenboom, M. R. Nevins, R. G. Whitfield, and R. S. Fuja Jul. 1991 98 p
(Contract W-31-109-eng-38)
(DE91-017241; ANL/EAIS/TM-52) Avail: NTIS HC/MF A05

This report presents the results of a study for US Special Operations Command to (1) evaluate commercially available knowledge-based system development tools within the context of the myriad needs of the Special Operations community, and (2) make recommendations regarding the acquisition and use of such tools. A comprehensive set of quantitative and qualitative evaluation criteria was defined and used to compare four candidate tools. Decision analysis techniques assisted four individuals knowledgeable about Special Operations in ranking the candidate tools. DOE

**N91-32033#** Tokyo Univ. (Japan). Research Center for Advanced Science and Technology.
**APPLICATION OF AI TO ENGINEERING PROBLEMS**
Setsuo Ohsuga *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 1-9 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32646*#** Air Force Geophysics Lab., Hanscom AFB, MA. Atmospheric Sciences Div.
**PREDICTING CLOUD-TO-GROUND LIGHTNING WITH NEURAL NETWORKS**
Arnold A. Barnes, Jr., Donald Frankel, and James Stark Draper (KTAADN, Inc., Newton, MA.) *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 1 Aug. 1991 10 p Previously announced in IAA as A90-19873, and as N91-18555 (For primary document see N91-32599 24-47)
Avail: NTIS HC/MF A99 CSCL 09B

## 64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

**N91-32861#** Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
**AN r-MATRIX APPROACH TO NONSTANDARD CLASSES OF INTEGRABLE EQUATIONS**
B. G. Konopelchenko (Institute of Nuclear Physics, Novosibirsk, USSR ) and W. Oevel Jul. 1991 65 p Sponsored by DFG
(MATHS-Rept-A-149; ETN-91-99890) Avail: NTIS HC/MF A04

Three different decompositions of the algebra of pseudodifferential operators and the corresponding r matrices are considered. Three associated classes of nonlinear integrable equations in 1 + 1 and 2 + 1 dimensions are discussed within the framework of generalized Lax equations and Sato's approach. The 2 + 1 dimensional hierarchies are associated with the Kadomtsev-Pietviashvili (KP) equation, the modified KP equation and a Dym equation, respectively. Reductions of the general hierarchies lead to other known integrable 2 + 1 dimensional equations as well as to a variety of integrable equations in 1 + 1 dimensions. It is shown, how the multi-Hamiltoninan structure of the 1 + 1 dimensional equations can be obtained from the underlying r matrices. Furthermore, intimate relations between the equations associated with the three different r matrices are revealed. The three classes are related by Darboux theorems originating from gauge transformations and reciprocal links of the Lax operators. These connections are discussed on a general level, leading to a unified picture on (reciprocal) Baecklund and auto-Baecklund transformations for large classes of integrable equations covered by the KP, the modified KP, and the Dym hierarchies. ESA

**N91-32862** Physics and Electronics Lab. TNO, The Hague (Netherlands).
**MAXIMUM LIKELIHOOD ESTIMATION APPLIED TO TARGET MOTION ANALYSIS USING SECOND ORDER DERIVATIVES**
**Final Report**
J. H. deVlieger Apr. 1991 70 p
(Contract A87/KM/172)
(FEL-89-A193; TD-90-4526; ETN-91-99994) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

The tracking problem of unknown marine platforms using passive sonar measurements is generally referred to as Target Motion Analysis (TMA). The application of a Maximum Likelihood Estimation (MLE) method to obtain position and velocity estimates of a platform when bearing angle and frequency measurements are available from a passive sonar system is described. The frequency measurements are related to one or more cardinal frequency peaks from the related frequency spectrum by the platform. The MLE method offers the opportunity to use a multi-leg model, i.e., the platform to be localized is assumed to move according to a piecewise linear track, where each part is referred to as a leg. On each leg, constant course and speed is assumed. Additionally, bearing and frequency measurements related to bottom reflections of the acoustical signals can be used. By using the analytic expressions of the derivatives as described, a major reduction of computation time of a Newton-type optimization method using first and second order derivative information of the residual functions is accomplished. ESA

**N91-32863#** Los Alamos National Lab., NM.
**EMPIRICAL RESULTS OF A HYBRID MONTE CARLO METHOD FOR THE SOLUTION OF POISSON'S EQUATION**
R. E. Hiromoto and R. G. Brickner 1991 8 p Presented at the 2nd International Conference on Applications of Supercomputers in Engineering, Boston, MA, 13-15 Aug. 1991
(Contract W-7405-eng-36)
(DE91-016240; LA-UR-91-2441; CONF-910824-1) Avail: NTIS HC/MF A02

The application of Monte Carlo techniques has considerable importance in solving computational problems that exhibit complex physical interactions and irregular spatial geometries. Yet equally important is the large computational parallelism that is inherent in these methods. With the current interest and emphasis on massively parallel computer systems, Monte Carlo methods would seem to be likely candidates for parallel implementation. However, parallelism in itself is only one metric for parallel computational performance. Measures such as load-balancing, data locality, communication latency, and numerical accuracy are equally important metrics for the evaluation of a parallel numerical algorithm. In this paper, a highly parallel Monte Carlo technique is modified and used in estimating the solution to Poisson's equation. This simple modification incorporating a more efficient use of boundary data appears to yield a better estimate to the exact solution. As a by product, the new approach is a more efficient sequential algorithm but at the expense of sacrificing parallelism. DOE

**N91-32864*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**MAPPING UNSTRUCTURED GRID PROBLEMS TO THE CONNECTION MACHINE**
Steven W. Hammond and Robert Schreiber Oct. 1990 20 p
(Contract NCC2-387)
(NASA-CR-187719; NAS 1.26:187719; RIACS-TR-90-22) Avail: NTIS HC/MF A03 CSCL 12A

We present a highly parallel graph mapping technique that enables one to solve unstructured grid problems on massively

parallel computers. Many implicit and explicit methods for solving discretizated partial differential equations require each point in the discretization to exchange data with its neighboring points every time step or iteration. The time spent communicating can limit the high performance promised by massively parallel computing. To eliminate this bottleneck, we map the graph of the irregular problem to the graph representing the interconnection topology of the computer such that the sum of the distances that the messages travel is minimized. We show that, in comparison to a naive assignment of processors, our heuristic mapping algorithm significantly reduces the communication time on the Connection Machine, CM-2. Author

**N91-32865*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**SPARSKIT: A BASIC TOOL KIT FOR SPARSE MATRIX COMPUTATIONS**
Youcef Saad 21 May 1990 30 p
(Contracts NCC2-387; DE-FG02-85ER-25001)
(NASA-CR-185876; NAS 1.26:185876; RIACS-TR-90-20) Avail: NTIS HC/MF A03 CSCL 12A

Presented here are the main features of a tool package for manipulating and working with sparse matrices. One of the goals of the package is to provide basic tools to facilitate the exchange of software and data between researchers in sparse matrix computations. The starting point is the Harwell/Boeing collection of matrices for which the authors provide a number of tools. Among other things, the package provides programs for converting data structures, printing simple statistics on a matrix, plotting a matrix profile, and performing linear algebra operations with sparse matrices. Author

**N91-32866#** California Univ., Berkeley. Lawrence Berkeley Lab.
**GRAPH THEORY AND THE VIRASORO MASTER EQUATION Ph.D. Thesis**
N. A. J. Obers Apr. 1991 54 p
(Contract DE-AC03-76SF-00098)
(DE91-016432; LBL-30634; UCB-PTH-91/24) Avail: NTIS HC/MF A04

A brief history of affine Lie algebra, the Virasoro algebra and its culmination in the Virasoro master equations is given. By studying ansaetze of the master equation, we obtain exact solutions and gain insight in the structure of large slices of affine-Virasoro space. We find an isomorphism between the constructions in the ansatz SO(n)(sub diag), which is a set of unitary, generically irrational affine-Virasoro constructions on SO(n), and the unlabelled graphs, while, conversely, a group-theoretic and conformal field-theoretic identification is obtained for every graph of graph theory. We also define a class of magic Lie group bases in which the Virasoro master equation admits a simple metric ansatz (gmetric), whose structure is visible in the high-level expansion. When a magic basis is real on compact g, the corresponding g(sub metric) is a large system of unitary, generically irrational conformal field theories. Examples in this class include the graph-theory ansatz SO(n)(sub diag) in the Cartesian basis of SO(n), and the ansatz SU(n)(sub metric) in the Pauli-like basis of SU(n). Finally, we define the sine-area graphs of SU(n), which label the conformal field theories of SU(n)(sub metric), and we note that, in similar fashion, each magic basis of g defines a generalized graph theory on g which labels the conformal field theories of g(sub metric). DOE

**N91-32867#** Oak Ridge National Lab., TN.
**SPLINE METHODS FOR CONSERVATION EQUATIONS**
C. Bottcher and M. R. Strayer 1991 24 p Presented at the 3rd International Association of Mathematics and Computers Simulation (IMACS) Symposium on Computational Acoustics, Cambridge, MA, 26-28 Jun. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017152; CONF-9106262-1) Avail: NTIS HC/MF A03

We consider the numerical solution of physical theories, in particular hydrodynamics, which can be formulated as systems of conservation laws. To this end we briefly describe the Basis Spline and collocation methods, paying particular attention to representation theory, which provides discrete analogues of the continuum conservation and dispersion relations, and hence a rigorous understanding of errors and instabilities. On this foundation we propose an algorithm for hydrodynamic problems in which most linear and nonlinear instabilities are brought under control. Numerical examples are presented from one-dimensional relativistic hydrodynamics. DOE

**N91-32868#** Superconducting Super Collider Lab., Dallas, TX.
**HAMILTONIANS AND LAGRANGIANS FOR ONE-DIMENSIONAL AUTONOMOUS SYSTEMS AND DISSIPATIVE SYSTEMS**
G. Lopez Jun. 1991 13 p
(Contract DE-AC35-89ER-40486)
(DE91-017595; SSCL-472) Avail: NTIS HC/MF A03

The Lagrangian and the Generalized Linear Momentum are given in terms of a constant of motion for a time-dependent system. The possibility of having an explicit Hamiltonian expression is also analyzed. To illustrate the method, the approach is applied to some dissipative systems. DOE

**N91-32869#** Oak Ridge National Lab., TN.
**GAUSSIAN ELIMINATION METHODS FOR CALCULATING CLASSICAL PERIODIC TRAJECTORIES IN TWO DIMENSIONS**
K. T. R. Davies Aug. 1991 14 p
(Contract DE-AC05-84OR-21400)
(DE91-017600; ORNL/TM-11902) Avail: NTIS HC/MF A03

A Gaussian-elimination method for calculating classical periodic trajectories is formulated for a two-dimensional system. Two variants of the theory are obtained, one assuming that the period of the motion is fixed and the other assuming that the total energy is fixed. Comparisons are made between various approaches. DOE

# 65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**N91-32870#** Oak Ridge National Lab., TN.
**THE CASE FOR LOWER PROBABILITIES AS MEASURES OF UNCERTAINTY**
B. Tonn and C. Wagner (Tennessee Univ., Knoxville.) 1991 16 p Presented at the Symposium on Expert System Applications for the Electric Power Industry, Boston, MA, 9-11 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017870; CONF-9109121-1) Avail: NTIS HC/MF A03

This paper presents the case for using lower probabilities as measures of uncertainty in expert systems. A debate has raged within the artificial intelligence community for years about how to represent uncertainty in expert systems. Several camps have emerged. One camp has focused on developing alternatives to probability theory, such as certainty factors, fuzzy sets, and endorsements. A second camp has focused on retrofitting classical, additive probability, for example, by developing a cautious approach to probabilistic reasoning and interpreting probability within a possible worlds framework. This paper falls into a third camp, which encompasses generalizations of probability theory. The most discussed generalization is known as Dempster-Shafer Theory, which is based on the combined work of Dempster and Shafer. Lower probabilities are actually a substantial generalization of DST. This paper has two parts. The first presents the definitions of lower probabilities, DST, and additive probability. This section includes a discussion of capacities, the most general type of uncertainty measure. The purpose of this section is to show the differences among the uncertainty measures. DOE

# 66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

No abstracts in this category.

# 67 THEORETICAL MATHEMATICS

Includes topology and number theory.

No abstracts in this category.

# 70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

No abstracts in this category.

# 71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

**N91-32871#** Centre Scientifique et Technique du Batiment, Saint-Martin-d'Heres (France).
**NEAR GROUND SOUND PROPAGATION IN WIND Final Report [PROPAGATION DU SON PRES DU SOL EN PRESENCE DE VENT]**
Y. Gabillet, Michel Rosen, Hartmut Schroeder, and Henri Maille May 1990 165 p In FRENCH
(Contract DRET-88-229)
(CSTB-2-89-003-4; ETN-91-99970) Avail: NTIS HC/MF A08

Gaussian beam computation in modeling of wind effects on planar surface acoustic propagation is addressed. A semi empirical treatment of grazing beams was carried out by applying the reflection coefficient of a spherical wave at grazing incidence to the reflected beams as a whole. This method gives results which agree with the cases studied. The new calculation model should enable a prediction tool for acoustic propagation in a real site, characterized by complex diffraction and effects from relief and atmospheric inhomogeneities, to be developed. ESA

**N91-32872** National Physical Lab., Teddington (England). Div. of Electrical Science.
**ACOUSTIC DAMPING OF HONEYCOMB-CONSTRUCTION PLATES BY PRESSURE-SENSITIVE ADHESIVES**
D. J. E. Knight and K. I. Pharaoh Apr. 1991 25 p Original contains color illustrations
(NPL-DES-107; ISSN-0143-7305; ETN-91-99867) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 OLW, England

Materials available as pressure sensitive adhesives in tape form are found to have suitable properties for damping acoustic vibrations in the 200 to 1000 Hz range. Comparative experiments were made to damp small honeycomb construction base plates, of length about 1 m and of thickness 50 mm, which are used for mounting lasers. Added masses bonded to the edge of the plate with the lossy adhesives are most effective in damping out of plane motion when placed where the edge has parallel rather than torsional motion for the particular Chladni's figure mode. A reduction of Q from about 100 to about 10 for modes between 218 and 800 Hz was achieved by an added 10 mass loading. When the lowest frequency mode is damped in this way the impact response sounds dead to the ear. ESA

**N91-32873** National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
**NOISE LEVELS OF USAF AIRCRAFT IN EXERCISE LUCE BELLE**
B. F. Berry, R. C. Payne, and A. L. Harris Feb. 1991 25 p Sponsored by Ministry of Defence
(NPL-RSA(EXT)-16; ISSN-0955-9655; ETN-91-99869) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 OLW, England

AIRNOISE, a mathematical model for computing aircraft noise contours is extended to include low altitude military operations. The objective is to predict not only maximum levels but also the onset rate of the noise of these very rapid events. To provide data with which to validate and refine the prediction model a trial was conducted (exercise Luce Belle) in which a number of different aircraft types were flown straight and level at heights between about 100 and 400 feet, at various speeds and engine power settings. The trial is reported and the results obtained for two USAF (U.S. Air Force) aircraft, an F-15 and an F-16, are presented. ESA

# 72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

**N91-32874** National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
**INTERCOMPARISON OF STANDARDS OF ABSORBED DOSE BETWEEN THE USSR AND THE UK**
V. A. Berlyand, J. I. Bregadze (All-Union Research Inst. for Physical and Radiotechnical Measurements, Mendeleevo, USSR ), J. E. Burns, A. R. DuSautoy, and P. H. G. Sharpe May 1991 20 p
(NPL-RSA(EXT)-17; ISSN-0955-9655; ETN-91-99870) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 OLW, England

A comparison of national standards of absorbed dose was carried out between the All-Union Research Institute for Physical Technical and Radiotechnical Measurements (VNIIFTRI), USSR, and the National Physical Laboratotry (NPL), UK (United Kingdom). Absorbed dose to water for cobalt 60 gamma radiation was compared by means of Fricke dosimeters and ionization chambers in 1985 and 1986. The primary standards used to derive absorbed dose to water were cavity ionization chambers at NPL and a graphite calorimeter at VNIIFTRI. The ratio of absorbed dose to water, NPL to VNIIFTRI, using Fricke dosimeters was 1.008; using ionization chambers it was 1.007. This agreement is within the estimated uncertainties of the standards and measurement methods. ESA

**N91-32875** National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
**ENVIRONMENTAL RADIOACTIVITY MEASUREMENT INTERCOMPARISON EXERCISE 1990**
S. M. Jerome May 1991 43 p
(NPL-RSA(EXT)-20; ISSN-0955-9655; ETN-91-99873) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 OLW, England

In a recent national intercomparison exercise, 49 laboratories involved in making environmental radioactivity measurements took part in the analysis of samples. There were two sets of samples: one containing pure beta emitters and one containing beta/gamma emitters. Two thirds of the participants measured the beta/gamma emitter sample only, the remainder measured both. ESA

**N91-32876#** Rutherford Appleton Lab., Chilton (England).
**THE EFFECT OF A NEUTRINO MAGNETIC MOMENT ON NUCLEAR EXCITATION PROCESSES**
A. C. Dodd, E. Papageorgiu, and S. Ranfone Feb. 1991 11 p
(RAL-91-010; ETN-91-99883) Avail: NTIS HC/MF A03

It is shown that MeV range neutrinos with a magnetic moment approximately equal to ten to the minus 11th power Bohr magnetons would excite nuclei, like C-12, with cross sections comparable to those obtained in the Standard Model. This implies the possibility of improving the present experimental bounds on the magnetic moment of any flavor of neutrinos by one order of magnitude. Such a magnetic moment would also enhance the coherent neutrino nuclear scattering in low temperature detectors, enabling them to set comparable limits. ESA

**N91-32877#** Rutherford Appleton Lab., Chilton (England). Theory Div.
**A UNIFIED FORMALISM FOR GAMMA GAMMA TO MESON AND PSI TO GAMMAX WITH POSSIBLE TESTS FOR HYBRID AND GLUONIC HADRONS**
F. E. Close and Z. P. Li (Tennessee Univ., Knoxville.) May 1991 40 p
(Contract DE-AS05-76ER-04936)
(RAL-91-039; ORNL-CCIP-91-08; UTK-91-003; ETN-91-99884)
Avail: NTIS HC/MF A03

The couplings of conventional and hybrid mesons to gamma gamma (real and virtual) and their production amplitudes in psi to gammaM are described in a unified manner. Existing results for heavy quarks are recovered; extensions to light quarks and to virtual gamma couplings are made; and phenomenological applications discussed. In particular relativistic corrections to gamma gamma to 0+, 1+, 2+ for both real and virtual photons are discussed and a resolution to a long standing puzzle in perturbative quantum chromodynamics concerning the helicity structure of psi to gamma 2++ is offered. It is suggested that the production of f sub 2 (1720) involves gluons in an essential way. ESA

**N91-32878#** Los Alamos National Lab., NM.
**INCONSISTENCIES WITH THE SINGLE IMPURITY UNDERSIGN MODEL IN PHOTOELECTRON SPECTRA OF CERIUM HEAVY FERMION COMPOUNDS**
J. J. Joyce, A. J. Arko, P. C. Canfield, Z. Fisk, R. J. Barlett, J. L. Smith, J. D. Thompson, and J. Lawrence (California Univ., Irvine.) 1991 17 p Presented at the 19th Rare Earth Research Conference, (RERC 19), Lexington, KY, 14-19 Jul. 1991
(Contract W-7405-eng-36)
(DE91-016239; LA-UR-91-2443; CONF-910706-3) Avail: NTIS HC/MF A03

We have re-examined the temperature-dependence of the valence band 4f features in Ce-based heavy fermions. We measured the phonon broadening of the Si-2p core levels in CeSi2 by determining the increase of the full width at half-maximum (FWHM) as a function of temperature. We discovered that all the temperature dependence is exactly accounted for, and there is none left over to attribute to any Kondo effects. We concluded that the feature of E sub F in Ce-based heavy fermions cannot be a Kondo resonance. DOE

**N91-32879#** California Univ., Berkeley. Lawrence Berkeley Lab.
**CROSSED BEAMS STUDIES OF NONADIABATIC COLLISION DYNAMICS Ph.D. Thesis**
A. G. Suits Jun. 1991 167 p
(Contract DE-AC03-76SF-00098)
(DE91-016250; LBL-30901) Avail: NTIS HC/MF A08

Nonadiabatic product channels have been studied for a variety of collision processes using crossed molecular beams under single collision conditions. Laboratory angular distributions, translational energy distributions and collision energy dependence have been measured for several chemiionization reactions in an effort to gain an understanding of the underlying collision dynamics. In addition, reactivity has been studied as a function of excited state orbital alignment in a number of these chemiionization reactions, and very strong alignment effects are observed. Chemiions Ba(+) and BaBr(+) produced in reaction of Ba (exp 1 S sub 0, exp 1 P sub 1) with Br2 were studied as a function of laboratory scattering angle, translational energy release, barium electronic state and alignment of the barium p orbital at collision energies of 1.1 and 1.5 eV. The contour map obtained for the BaBr(+) product indicates a close near-collinear collision is required to gain access to the region in which the second electron transfer may occur. Chemiions Ba(+), BaO(+), BaO2(+) from reaction of ground state and electronically excited Ba with O3 were studied in an effort to extend the insights obtained in the Br2 studies to an atom-triatom system. A profound dependence of reactive signal on orbital alignment was observed at some scattering angles, despite the reduced symmetry of these systems compared to Br2. Contour maps of scattered Ba(exp 3 P2) flux from collision of Ba(exp 1 P1) with O2 and N2 were obtained from simulations of measured Ba(exp 3 P2). Doppler spectra were taken at a variety of probe laser angles in a crossed beams experiment. DOE

**N91-32880#** California Univ., Berkeley. Lawrence Berkeley Lab.
**EFFECTIVE THEORIES AND THRESHOLDS IN PARTICLE PHYSICS**
M. K. Gaillard Jun. 1991 8 p Presented at the Conference on Gauge Theories: Past and Future, Ann Arbor, MI, 16-18 May 1991
(Contract DE-AC03-76SF-00098)
(DE91-016257; LBL-30801; UCB-PTH-91/26; CONF-9105239-1)
Avail: NTIS HC/MF A02

The role of effective theories in probing a more fundamental underlying theory and in indicating new physics thresholds is discussed, with examples from the standard model and more speculative applications to superstring theory. DOE

**N91-32881#** Oak Ridge National Lab., TN.
**A DYNAMICAL PICTURE OF HADRON-HADRON COLLISIONS WITH THE STRING-PARTON MODEL**
D. J. Dean, A. S. Umar, and J. S. Wu 1991 13 p Presented at the Conference on Computational Quantum Physics, Nashville, TN, 22-25 May 1991 Prepared in cooperation with Vanderbilt Univ., Nashville, TN
(Contract DE-AC05-84OR-21400)
(DE91-016278; CONF-9105238-1) Avail: NTIS HC/MF A03

We introduce a dynamical model for the description of hadron-hadron collisions at relativistic energies. The model is based on classical Nambu-Goto strings. The string motion is performed in unrestricted four-dimensional space-time. The string endpoints are interpreted as partons which carry energy and momentum. We study e(+) e(-), e -- p, and p -- p collisions at various center of mass energies. The three basic features of our model are as follows. An ensemble of strings with different endpoint dynamics is used to approximately reproduce the valence quark structure functions. We introduce an adiabatic hadronization mechanism for string breakup via q(bar q) pair production. The interaction between strings is formulated in terms of a quark-quark scattering amplitude and exchange. This model will be used to describe relativistic heavy-ion collisions in future work. DOE

**N91-32882#** Los Alamos National Lab., NM.
**MEASUREMENTS OF INDUCED RADIOACTIVITY IN SOME LDEF SAMPLES**
C. E. Moss and R. C. Reedy 1991 24 p Presented at the 1st Long Duration Exposure Facility Post-Retrieval Symposium, Kissimmee, FL, 3-8 Jun. 1991
(Contract W-7405-eng-36)
(DE91-016309; LA-UR-91-2540; CONF-9106256-1) Avail: NTIS HC/MF A03

Twenty-six stainless steel trunnion samples, five aluminum end support retainer plate samples, two aluminum keel plate samples, and two titanium clips were analyzed. The shielded high purity germanium detectors used had efficiencies of 33,, 54, and 80 pcts. at 1332 keV. Detector efficiencies as a function of energy

and corrections for self-absorption in the samples were determined with calibrated sources and unactivated control samples. Several measurements were made on most samples. In the trunnion samples, Mn-54 and Co-57 were seen and limits were obtained for other isotopes. The results agree well with 1-D activation calculations for an anisotropic trapped proton model. In the aluminum and titanium samples, Na-22 was seen. Other results are presented. DOE

**N91-32883#** Stanford Linear Accelerator Center, CA.
**SOFT AND HARD POMERONS: IS THERE A DISTINCTION?**
J. D. Bjorken Jul. 1991 12 p Presented at the 4th International Conference on Elastic and Diffractive Scattering, Isola D'Elba (Italy), 22-25 May 1991
(Contract DE-AC03-76SF-00515)
(DE91-016048; SU-SLAC-PUB-5608; CONF-9105241-1) Avail: NTIS HC/MF A03

One of the big unsolved problems of quantum chromodynamics (QCD) remains the problem of the Pomeron: What is the relation of high energy elastic and diffractive phenomena to the underlying theory? This is not a subject in which I have actively worked. But my interest in it has increased greatly in the last year. The reason has to do with ideas for experimentation which either directly address the problem or which require the understanding of strong-interaction diffractive phenomena as backgrounds for discovery-physics processes involving electroweak boson exchanges. I will in this talk omit these motivations, which can be found elsewhere, and instead concentrate on some personal viewpoints regarding the Pomeron which may or may not be conventional. The main question has to do with the distinction between the original, old-fashioned soft Pomeron of the 1960s, built out of multiperipheral hadron-exchanges, and the more modern perturbative-QCD hard Pomeron, built out of multiperipheral gluon exchanges. The perspective I offer comes mainly from two sources: one is heavy-flavor physics, and the other is the Manohar-Georgi view of constituent quark physics. DOE

**N91-32884#** Oak Ridge National Lab., TN.
**ULTRARELATIVISTIC ATOMIC COLLISIONS**
C. Bottcher and M. R. Strayer 1991 10 p Presented at the 17th International Conference on the Physics of Electronic and Atomic Collisions, Brisbane (Australia), 10-16 Jul. 1991
(Contract DE-AC05-84OR-21400)
(DE91-016768; CONF-910746-3) Avail: NTIS HC/MF A02

Calculations of the coherent production of free pairs and of pair production with electron capture from ultrarelativistic ion-ion collisions are discussed. Theory and experiment are contrasted, with some conjectures on the possibility of new phenomena. DOE

**N91-32885#** Lawrence Livermore National Lab., CA.
**HIGH-INTENSITY PHOTOIONIZATION OF H2**
S. W. Allendorf and A. Szoeke May 1991 6 p Presented at the Conference on Short-Wavelength Coherent Radiation: Generation and Application, Monterey, CA, 4-10 Apr. 1991
(Contract W-7405-eng-48)
(DE91-017087; UCRL-JC-103342; CONF-9104164-7) Avail: NTIS HC/MF A02

A tunable, high intensity picosecond dye laser system has been employed with electron energy analysis to investigate the dynamics of (3+1) resonance-enhanced multiphoton ionization of H2 via different vibrational levels of its B sup 1 Sigma sub u sup + and C sup 1 Pi sub u electronic states. We observe production of molecular ions in various vibrational levels, with a shift to increased population of lower vibrational states of H2(+) consistent with the a.c. Stark shift of the correspondingly lower vibrational levels of the C state into resonance with the three photon energy of the laser. Clear evidence of direct dissociation of H2 followed by single photon ionization of the excited H atom is observed as well. Above threshold ionization of these two processes occurs readily. We also find that dissociative ionization is an increasingly important ionization pathway as the wavelength is increased. Finally, we see evidence of a new ionization pathway, which we assign to photoionization into a transient bound state created by the avoided crossing of the first repulsive electronic state of H2(+), with the single photon dressed ground state of H2(+). DOE

**N91-32886#** Lawrence Livermore National Lab., CA.
**BENCHMARK FIELD STUDY OF DEEP NEUTRON PENETRATION**
J. F. Morgan, K. Sale, R. Gold, J. H. Roberts, and C. C. Preston 10 Jun. 1991 7 p Presented at the 7th ASTM-EURATOM Symposium on Reactor Dosimetry, Strasbourg, France, 27-31 Aug. 1990
(Contract W-7405-eng-48)
(DE91-015677; UCRL-JC-107423; CONF-900814-19) Avail: NTIS HC/MF A02

A unique benchmark neutron field has been established at the Lawrence Livermore National Laboratory (LLNL) to study deep penetration neutron transport. At LLNL, a tandem accelerator is used to generate a monoenergetic neutron source that permits investigation of deep neutron penetration under conditions that are virtually ideal to model, namely the transport of mono-energetic neutrons through a single material in a simple geometry. General features of the Lawrence Tandem (LATAN) benchmark field are described with emphasis on neutron source characteristics and room return background. The single material chosen for the first benchmark, LATAN-1, is a steel representative of Light Water Reactor (LWR) Pressure Vessels (PV). Also included is a brief description of the Little Boy replica, a critical reactor assembly designed to mimic the radiation doses from the atomic bomb dropped on Hiroshima, and its us in neutron spectrometry. DOE

**N91-32887#** Texas A&M Univ., College Station. Dept. of Physics.
**STUDY OF NEUTRON-PROTON INTERACTION IN THE 300 TO 700 MeV ENERGY REGION**
L. C. Northcliffe and J. C. Hiebert Jul. 1991 10 p
(Contract DE-FG05-88ER-40399)
(DE91-016487; DOE/ER-40399/4) Avail: NTIS HC/MF A02

The primary objective of this program is investigation of the nucleon-nucleon (NN) interaction, in the medium energy region, in both elastic and inelastic channels. This TAMU group has been working in pursuit of that objective primarily at LAMPF, but also in a few experiments at Brookhaven National Laboratory (BNL) and one experiment at the Japanese National Laboratory for High Energy Physics (KEK). DOE

**N91-32888#** Argonne National Lab., Idaho Falls, ID.
**HADRONIC PHOTONS AND COLLIDER DIFFRACTIVE PHYSICS**
K. Kang (Brown Univ., Providence, RI.) and A. R. White 12 Nov. 1990 5 p Presented at the 20th International Symposium on Multiparticle Dynamics, Gut Holmecke (Germany), 10-14 Sep. 1990
(Contract W-31-109-eng-38)
(DE91-016514; ANL/CP-71880; ANL-HEP-CP-90-99; CONF-9009315-6) Avail: NTIS HC/MF A01

The large UA4 real part, diffractive air shower exotics and the hadronic behavior of high energy photons are linked together as possible evidence for a sextet-quark sector of quantum chromodynamics. Our analysis implies that a short lived axion-like sextet eta of mass O(30 GeV), with two photons as major decay mode, should be produced diffractively at hadron colliders. DOE

**N91-32889#** Brookhaven National Lab., Upton, NY.
**LIQUID AND SOLID Ga AND Bi STUDIES WITH A VARIABLE ENERGY POSITRON BEAM**
E. Gramsch, K. G. Lynn, J. Throwe, and I. Kanazawa 1990 6 p Presented at the 7th Chilean Conference on Physics, Santiago (Chile), 18-21 Dec. 1990
(Contract DE-AC02-76CH-00016)
(DE91-016910; BNL-46442; CONF-9012104-1) Avail: NTIS HC/MF A02

The diffusion length of positrons has been measured in liquid and solid gallium and bismuth using a vertical positron beam. For

Ga our results indicate a drop in the diffusion length from 1200 (100) to 30 (5) Angstrom as the sample melts, as the temperature is increased there is a surprising increase in the diffusion length. At the melting point the annihilation parameter S in the bulk increases sharply, and stays constant with temperature, which indicates that vacancy size trapping centers exist in the liquid. For Bi, the diffusion length drops in the liquid from 500 to 200 Angstrom, and increases slightly as the temperature is increased. This drop is interpreted in terms of increased scattering with Bi ions. A small change is observed in bulk S, indicating no trapping of positrons as the sample melts. This behavior, which is so different in these two metals, indicates the sensitivity of positrons to the liquid structure. DOE

**N91-32890#** Washington Univ., Seattle. Dept. of Physics.
**COLOR TRANSPARENCY: ENCHANTMENT AND EFFORT**
G. A. Miller and B. K. Jennings (Tri-Univ. Meson Facility, Vancouver, British Columbia ) 1991 11 p Presented at the 5th Workshop on Perspectives in Nuclear Physics at Intermediate Energies, Trieste (Italy), 6-10 May 1991
(Contract DE-FG06-88ER-40427)
(DE91-016951; DOE/ER-40427/12-N91; CONF-9105222-2)
Avail: NTIS HC/MF A03

A quantum mechanical approach is used to study high momentum transfer reactions in which a nucleon is knocked out of the nucleus. We show that the nuclear interactions of the wave packet produced in such a process tend to cancel, so that the nuclear medium becomes transparent. The wave packet (ejectile)-nucleon interactions, including the production of nucleon resonances are also discussed. Color transparency effects in the (e,e(prime)p) reaction may be significant at relatively low momentum transfer Q(exp 2) = 3 (minus) 6 (GeV(exp 2)/c)(exp 2). DOE

**N91-32891#** Los Alamos National Lab., NM.
**INTERNATIONAL WORKSHOP ON COLD NEUTRON SOURCES**
G. J. Russell and C. D. West Aug. 1991 666 p Presented at the International Workshop on Cold Neutron Sources, Los Alamos, NM, 5-8 Mar. 1990 Prepared in cooperation with Oak Ridge National Lab., TN
(Contracts W-7405-eng-36; DE-AC05-84OR-21400)
(DE91-017559; LA-12146-C; CONF-9003100) Avail: NTIS HC/MF A99

The first meeting devoted to cold neutron sources was held at the Los Alamos National Laboratory on March 5 to 8, 1990. Cosponsored by Los Alamos and Oak Ridge National Laboratories, the meeting was organized as an International Workshop on Cold Neutron Sources and brought together experts in the field of cold-neutron-source design for reactors and spallation sources. Eighty-four people from seven countries attended. Because the meeting was the first of its kind in over forty years, much time was spent acquainting participants with past and planned activities at reactor and spallation facilities worldwide. As a result, the meeting had more of a conference flavor than one of a workshop. The general topics covered at the workshop included: Criteria for cold source design; neutronic predictions and performance; energy deposition and removal; engineering design, fabrication, and operation; material properties; radiation damage; instrumentation; safety; existing cold sources; and future cold sources. DOE

**N91-32892#** Los Alamos National Lab., NM.
**X RAY ABSORPTION FINE STRUCTURE OF SYSTEMS IN THE ANHARMONIC LIMIT**
J. MustredeLeon, S. D. Conradson, I. Batistic, A. R. Bishop, I. Raistrick, W. E. Jackson, and G. E. Brown (Stanford Univ., CA.) 1991 13 p Presented at the Conference on X Rays in Materials Analysis 2: Novel Applications and Recent Developments, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-36)
(DE91-016070; LA-UR-91-2257; CONF-9107128-1) Avail: NTIS HC/MF A03

A new approach to the analysis of x-ray absorption fine structure (XAFS) data is presented. It is based on the use of radial distribution functions directly calculated from a single-particle ion Hamiltonian containing model potentials. The starting point of this approach is the statistical average of the XAFS for an atomic pair. This average can be computed using a radial distribution function (RDF), which can be expressed in terms of the eigenvalues and wavefunctions associated with the model potential. The pair potential describing the ionic motion is then expressed in terms of parameters that are determined by fitting this statistical average to the experimental XAFS spectrum. This approach allows the use of XAFS as a tool for mapping near-neighbor interatomic potentials, and allows the treatment of systems which exhibit strongly anharmonic potentials which can be treated by perturbative methods. Using this method we have analyzed the high temperature behavior of the oxygen contributions to the Fe K-edge XAFS in the ferrosilicate minerals andradite (Ca3Fe2Si3O12) and magnesiowustite (Mg(0.9)Fe(0.1)O). Using a temperature dependent anharmonic correction derived from these model compounds, we have found evidence for a local structural change in the Fe-O coordination environment upon melting of the geologically important mineral fayalite (Fe2SiO4). We have also employed this method to the study of the axial oxygen contributions to the polarized Cu K-edge XAFS on oriented samples of YBa2Cu3O7 and related compounds. From this study we find evidence for an axial oxygen-centered lattice distortion accompanying the superconducting phase transition and a correlation between this distortion and Tc. The relation of the observed lattice distortion to mechanisms of superconductivity is discussed. DOE

**N91-32893#** Brookhaven National Lab., Upton, NY.
**HIGH-ENERGY SYNCHROTRON RADIATION X RAY MICROSCOPY: PRESENT STATUS AND FUTURE PROSPECTS**
K. W. Jones, B. M. Gordon, P. Spanne, M. L. Rivers, and S. R. Sutton (Illinois Univ., Chicago.) 1991 10 p Presented at the Workshop on Application of Synchrotron Radiation To Chemical Engineering Science, Argonne, IL, 22-23 Apr. 1991
(Contract DE-AC02-76CH-00016)
(DE91-016894; BNL-46409; CONF-9104201-2) Avail: NTIS HC/MF A02

High-energy radiation synchrotron x-ray microscopy is used to characterize materials of importance to the chemical and materials sciences and chemical engineering. The x-ray microscope (XRM) forms images of elemental distributions fluorescent x rays or images of mass distributions by measurement of the linear attenuation coefficient of the material. Distributions of sections through materials are obtained nondestructively using the technique of computed microtomography. The energy range of the x rays used for the XRM ranges from a few keV at the minimum value to more than 100 keV, which is sufficient to excite the K-edge of all naturally occurring elements. The work in progress at the Brookhaven NSLS X26 and X17 XRM is described in order to show the current status of the XRM. While there are many possible approaches to the XRM instrumentation, this instrument gives state-of-the-art performance in most respects and serves as a reasonable example of the present status of the instrumentation in terms of the spatial resolution and minimum detection limits obtainable. The examples of applications cited give an idea of the types of research fields that are currently under investigation. They can be used to illustrate how the field of x-ray microscopy will benefit from the use of bending magnets and insertion devices at the advanced photon source. DOE

**N91-32894#** Wisconsin Univ., Madison. Dept. of Medical Physics.
**FAST NEUTRON DOSIMETRY**
P. M. DeLuca, Jr. and D. W. Pearson 1991 100 p
(Contract DE-FG02-86ER-60417)
(DE91-016907; DOE/ER-60417/T3) Avail: NTIS HC/MF A05

During 1988 to 1990, the magnetic resonance dosimetry project was completed, as were the 250 MeV proton shielding measurements. The first cellular experiment using human cells in vitro at the 1 GeV electron storage ring was also accomplished. More detail may be found in DOE Report (number sign)DOE/EV/60417-002 and the open literature cited in the

individual progress subsections. We report Kinetic Energy Released in Matter (KERMA), factor measurements in several elements of critical importance to neutron radiation therapy and radiation protection for space habitation and exploration for neutron energies below 30 MeV. The results of this effort provide the only direct measurements of the oxygen and magnesium kerma factors above 20 MeV neutron energy, and the only measurements of the iron kerma factor above 15 MeV. They provide data of immediate relevance to neutron radiotherapy and impose strict criteria for normalizing and testing nuclear models used to calculate kerma factors at higher neutron energies. DOE

**N91-32895#** Syracuse Univ., NY.
**RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY (TASK A)**
A. P. Balachandran, C. Rosenzweig, J. Schechter, and K. C. Wali 1991 65 p
(Contract DE-FG02-85ER-40231)
(DE91-016937; DOE/ER-40231/T11) Avail: NTIS HC/MF A04

In this paper we give a brief account of the work of the group during the past year. It may be put in context by referring to last years' progress report which contained a detailed summary of our work during the five previous years. The topics covered include: (1) Topological defects and their applications to QCD; (2) Skyrme model; (3) Non-commutative geometry and particle physics; (4) Spin and statistics; (5) Quantum bundles and their symmetries; and (6) Physics of the electroweak interactions. DOE

**N91-32896#** Arizona State Univ., Tempe. Dept. of Chemistry.
**PHOTOINITIATED ELECTRON TRANSFER IN MULTI-CHROMOPHORIC SPECIES: SYNTHETIC TETRADS AND PENTADS FEATURING DIQUINONE MOIETIES**
30 Apr. 1991 14 p
(Contract DE-FG02-87ER-13791)
(DE91-017413; DOE/ER-13791/5) Avail: NTIS HC/MF A03

This research project is concerned with the design, synthesis and study of complex molecular devices containing combinations of four or five chromophores, electron donors and electron acceptors. Properly engineered molecules of this type can functionally mimic photosynthetic light harvesting, photoinitiated multistep electron transfer to generate charge separated states, and photoprotection from light-initiated singlet oxygen damage. New quinone-porphyrin linkages have been designed and synthesized in this reporting period. Details of the synthesis and spectroscopic properties of some of the molecules are reported. In addition, new photochemical and photophysical studies of the tetrads and pentads are under way, with some early results presented. Linkage of these compounds to a conducting or semiconducting surface may enhance their function, and scanning tunneling microscopy is being used to examine the structural and photophysical properties of such a linkage. DOE

**N91-32897#** Joint Inst. for Lab. Astrophysics, Boulder, CO.
**ATOMIC AND MOLECULAR COLLISION PROCESSES**
D. W. Norcross 3 Apr. 1991 10 p
(Contract DE-AI01-87ER-13656)
(DE91-017649; DOE/ER-13656/T3) Avail: NTIS HC/MF A02

Accomplishments during the course of a 44-month program of code development and high precision calculations for electron collisions with atoms, atomic ions, and molecules are summarized. In electron-atom and -ion collisions, we were primarily concerned with the fundamental physics of the process that controls excitation in high temperature plasmas. In the molecular work, we pursued the development of techniques for accurate calculations of ro-vibrational excitation of polyatomic molecules, to the modeling of gas-phase laser systems. Highlights from the seven technical paper published as a result of this contract include: The resolution of a long history of unexplained anomalies and experimental/-theoretical discrepancies by a demonstration that the Coulomb phase must be included in scattering amplitudes for electron-ion collisions. Definitive close-coupling calculations of cross sections for electron impact excitation of Be(+), using a very elaborate expansion for the collision system and inclusion of both one- and two-body terms for the effect of core polarization. Detailed state-of-the-art calculations for electron-impact excitation of the sodium-like ion Al(2+) that included core-polarization interactions, and which also produced new data on bound-state energy levels for the magnesium-like ion Al(+) and oscillator strengths for Al(2+). Partial cross sections for excitation of the 3p level of sodium at energies just above threshold calculated using a four-state close-coupling approach, including both total cross sections and those for excitation as a function of the change in the spin and orbital angular momentum projection quantum numbers of the target electron. Generalization of our electron-molecule scattering code to carry out full vibrational close-coupling calculations with an exact treatment of exchange and with a parameter-free representation of correlation and polarization interactions, and application to HF and H2. DOE

**N91-32898#** Lawrence Livermore National Lab., CA.
**BASIC FEATURES OF COHERENT RADIATION GENERATED BY RELATIVISTIC CHARGE BUNCHES**
M. J. Moran and B. Chang Nov. 1990 15 p Presented at the 13th Werner Brandt Workshop on the Interaction of Charged Particles with Matter, Nara, Japan, 16-18 Nov. 1990
(Contract W-7405-eng-48)
(DE91-017656; UCRL-JC-105079; CONF-901188-3) Avail: NTIS HC/MF A03

Radiation generated by relativistic charges can be analyzed and described in exquisite detail. One reason that such detailed analysis is possible is because the phases of radiated photons often are determined completely by the initial conditions of the relativistic charges and the radiating system. The phase relationships between the initial charges and the radiated photons represent coherence in the emitted radiation. A previous paper described how this coherence could affect the spatial and spectral distributions of radiation generated by a single charge in a periodic radiator. The present paper discusses a complementary issue; namely, how the temporal shape of a relativistic charge bunch can emphasize specific features of the radiation generated at a single interaction site. DOE

**N91-32899#** Oak Ridge National Lab., TN.
**THE EXTENSION OF THE HHIRF ACCELERATORS TO PRODUCE RADIOACTIVE ION BEAMS**
D. K. Olsen, G. D. Alton, C. Baktash, D. T. Dowling, J. D. Garrett, D. L. Haynes, C. M. Jones, R. C. Juras, S. N. Lane, and I. Y. Lee et al 1991 7 p Presented at the 2nd International Conference on Radioactive Nuclear Beams, Louvain, Belgium, 19-21 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017687; CONF-910815-2) Avail: NTIS HC/MF A02

The production of medium-intensity, proton-rich, radioactive ion beams for nuclear physics, astrophysics, and applied research with the HHIRF accelerators is discussed. Radioactive atoms will be produced with fusion reactions by light ion beams from the K = 105 Oak Ridge Isochronous Cyclotron stopping in an ISOLDE-type thick target mounted on a 300-kV high voltage platform. These radioactive atoms will be ionized, mass separated, and charge exchanged to negative ions on the high voltage platform prior to injection into the HHIRF 25-MV tandem accelerator. Beams of up to mass 80 will be accelerated to energies greater than 5 MeV/nucleon. For some radioactive beams, intensities greater than 1 pnA can be expected. DOE

**N91-32900#** Los Alamos National Lab., NM.
**GIANT RESONANCES IN SINGLE AND DOUBLE CHARGE EXCHANGE**
S. Mordechai and C. F. Moore (Texas Univ., Austin.) 1991 11 p Presented at the International Workshop on Pions in Nuclei, Penyscola, Spain, 2-9 Jun. 1991
(Contract W-7405-eng-36)
(DE91-017822; LA-UR-91-2564; CONF-9106194-2) Avail: NTIS HC/MF A03

A long-standing issue in nuclear physics is whether or not multiple excitations of the giant-dipole resonance do exist. Recent

studies at LAMPF using pion-induced double-charge exchange reactions show the existence of previously unobserved giant resonances in the continuum at high-excitation energies. Based on their energies, characteristic angular distributions, and the cross sections at which the resonances are observed, they have been identified as two different types of double-collective-excitation modes of the nucleus: (1) the isovector giant-dipole resonance built on the isobaric analog state, and (2) the isovector giant-dipole resonance built on the giant dipole. In this report we will discuss the general features of the new resonances as they have emerged from DCX experiments performed recently at LAMPF. DOE

**N91-32901#** Los Alamos National Lab., NM.
**SINGLE- AND DOUBLE-CHARGE EXCHANGE AT LOW PION ENERGIES**
H. W. Baer 1991 20 p Presented at the International Workshop on Pions in Nuclei, Penyscola, Spain, 2-9 Jun. 1991
(Contract W-7405-eng-36)
(DE91-017829; LA-UR-91-2827; CONF-9106194-5) Avail: NTIS HC/MF A03

A review is given of pion single- and double-charge exchange reactions at incident energies of 25 to 65 MeV leading to isobaric analog states, and in the case of double-charge exchange leading to the ground state of the residual nucleus. The crucial role of the higher nuclear transparency at low pion energies for the analysis of the data in terms of single and double scattering is demonstrated. The large effects on double-charge exchange produced by the spatial correlations in nuclear wave functions are evident. The data on 1f(sub 7/2) nuclei at 35 MeV are used to establish the general validity of a shell-model-based two-amplitude model for these transitions. Recent measurements of the energy dependence between 25 and 65 MeV of double-charge exchange cross sections at forward angles are presented and discussed. DOE

**N91-32902#** Oak Ridge National Lab., TN.
**HIGH ENERGY SPIN WAVES IN IRON MEASURED BY NEUTRON SCATTERING**
A. T. Boothroyd, D. M. Paul, T. G. Perring, A. D. Taylor (Science Research Council, Chilton, England ), and H. A. Mook 1991 9 p Presented at the International Conference on Magnetism, Edinburgh, Scotland, 1-7 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017868; CONF-910903-9) Avail: NTIS HC/MF A02

We present new results for the spin wave dispersion relation measured along the (zeta zeta 0) direction in bcc iron (12 pct. silicon) by time-of-flight, neutron inelastic scattering. The excitations were followed to the zone boundary, where they are spread over a range of energies around 300 meV. DOE

**N91-32038#** Nippon Electric Co. Ltd., Tokyo (Japan).
**CONSERVATION OF ANGULAR MOMENTUM IN DIRECT SIMULATION MONTE CARLO METHOD**
Sadamu Saito *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1990 p 45-48 In JAPANESE; ENGLISH summary (For primary document see N91-32032 24-01)
Avail: NTIS HC/MF A14

**N91-32726*#** Electro Magnetic Applications, Inc., Lakewood, CO.
**ELECTRON DISTRIBUTION FUNCTIONS IN ELECTRIC FIELD ENVIRONMENTS**
Terence H. Rudolph *In* NASA. Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 2 Aug. 1991 10 p (For primary document see N91-32693 24-47)
(Contract DAAL02-89-C-0075)
Avail: NTIS HC/MF A20 CSCL 20H

# 73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

**N91-32903#** Oak Ridge National Lab., TN.
**COMPUTER SIMULATION STUDIES OF HIGH ENERGY COLLISION CASCADES**
M. T. Robinson Jul. 1991 15 p Presented at the 14th International Conference on Atomic Collisions in Solids, Salford, England, 29 Jul. - 2 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE91-016225; CONF-9107155-1) Avail: NTIS HC/MF A03

A modified binary collision approximation allowing the proper order of the collisions in time was used to study cascades in Cu and Au at primary kinetic energies up to 100 keV. Nonlinearities were approximated by letting already-stopped cascade atoms become targets in later collisions, using an improved method of locating potential targets to extend the calculations to energies much higher than heretofore. Beside the effect of the approximate nonlinearity, the effect of thermal disorder in the targets was examined. Target redisplacements reduce the damage in Cu by 3 percent at most, but in Au they reduce it by amounts up to 20 percent at 100 keV. Thermal disorder is also important: by disrupting crystal effects, the damage is reduced significantly. DOE

**N91-32904#** Los Alamos National Lab., NM.
**A PULSED LEPTON SOURCE AT LAMPF**
D. H. White 1991 5 p Presented at the Conference on the Intersections Between Particle and Nuclear Physics, Tucson, AZ, 23-29 May 1991
(Contract W-7405-eng-36)
(DE91-016010; LA-UR-91-2407; CONF-9105106-23) Avail: NTIS HC/MF A01

A Pulsed Lepton Source is being considered at the LAMPF facility at Los Alamos National Laboratory. The plan for the source is described together with a description of the accelerator components and performance as they exist at present. DOE

**N91-32905#** Los Alamos National Lab., NM.
**ADVANCED HIGH BRIGHTNESS ION RF ACCELERATOR APPLICATIONS IN THE NUCLEAR ENERGY**
R. A. Jameson 1991 9 p Presented at the Sympcsium on High Brightness Beams for Advanced Accelerator Applications, College Park, MD, 6-7 Jun. 1991
(Contract W-7405-eng-36)
(DE91-016075; LA-UR-91-2196; CONF-9106260-1) Avail: NTIS HC/MF A02

The capability of modern RF linear accelerators to provide intense high quality beams of protons, deuterons, or heavier ions is opening new possibilities for: transmuting existing nuclear wastes; generating electricity from readily available fuels with minimal residual wastes; building intense neutron sources for materials research; inertial confinement fusion using heavy ions; and other new applications. These are briefly described, couched in a perspective of the advances in the understanding of the high brightness beams that has enabled these new programs. DOE

**N91-32906#** Stanford Linear Accelerator Center, CA.
**COMPUTATION APPLIED TO PARTICLE ACCELERATOR SIMULATIONS**
W. B. Herrmannsfeldt and Y. T. Yan Jul. 1991 7 p Presented at the Conference on Computational Quantum Physics, Nashville, TN, 22-25 May 1991
(Contract DE-AC03-76SF-00515)
(DE91-017128; SU-SLAC-PUB-5601; CONF-9105238-4) Avail: NTIS HC/MF A02

The rapid growth in the power of large scale computers has had a revolutionary effect on the study of charged particle accelerators that is similar to the impact of smaller computers on everyday life. Before an accelerator is built, it is now the absolute

rule to simulate every component and subsystem by computer to establish modes of operation and tolerances. We will bypass the important and fruitful areas of control and operation and consider only application to design and diagnostic interpretation. Applications of computers can be divided into separate categories including: component design, system design, stability studies, cost optimization, and operating condition simulation. For the purposes of this report, we will choose a few examples taken from the above categories to illustrate the methods and we will discuss the significance of the work to the project, and also briefly discuss the accelerator project itself. The examples that will be discussed are: (1) the tracking analysis done for the main ring of the Superconducting Supercollider, which contributed to the analysis which ultimately resulted in changing the dipole coil diameter to 5 cm from the earlier design for a 4 cm coil diameter dipole magnet; (2) the design of accelerator structures for electron-positron linear colliders and circular colliding beam systems (B-factories); (3) simulation of the wake fields from multibunch electron beams for linear colliders; and (4) particle-in-cell simulation of space charge dominated beams for an experimental liner induction accelerator for Heavy Ion Fusion. DOE

**N91-32907#** Brookhaven National Lab., Upton, NY.
**ION CLEARING AND PHOTOELECTRON PRODUCTION IN THE 200 MeV SXLS RING**
H. Halama and E. Bozoki 1991 4 p Presented at the Institute of Electrical and Electronics Engineers (IEEE) Particle Accelerator Conference (PAC), San Francisco, CA, 6-9 May 1991
(Contract DE-AC02-76CH-00016)
(DE91-017156; BNL-46471; CONF-910505-398) Avail: NTIS HC/MF A01

The design of the Superconducting X ray Lithography Source (SXLS) clearing system and its behavior are presented. In normal 200 MeV operation, clearing electrode current is dominated by photoelectrons. Clearing electrodes appear essential only in several locations but not in the dipoles. The effect of clearing voltage on the tune and the beam profile is also discussed. DOE

**N91-32908#** Sandia National Labs., Albuquerque, NM.
**VISIBLE SPECTROSCOPY DIAGNOSTICS OF LIGHT-ION BEAMS**
J. E. Bailey, A. L. Carlson, A. B. Filuk, T. J. Nash, and Y. Maron 1991 9 p Presented at the International School of Plasma Physics Piero Caldirola' Diagnostics for Contemporary Fusion Experiments, Varenna, Italy, 27 Aug. - 6 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE91-017450; SAND-91-0998C; CONF-910857-1) Avail: NTIS HC/MF A02

Visible spectroscopy is used to explore the physics of a high power light ion diode driven by the PBFA-2 accelerator. The diagnostic system uses fiber optics to transport light from the diode to a remote screen room, where a streaked spectrograph records time resolved spectra. Calibrations include characterization of the fiber link, collection efficiency, and absolute instrument sensitivity. Data is obtained from the ion source anode plasma, the plasma opening switch, and the beam transport gas cell. The spectra are useful in determining the ion source formation mechanism, the beam divergence, opening switch composition and motion, and the neutralization of the ion beam transport. DOE

**N91-32909#** California Univ., Berkeley. Lawrence Berkeley Lab.
**EMITTANCE VARIATIONS IN CURRENT-AMPLIFYING ION INDUCTION LINACS**
T. J. Fessenden Apr. 1991 5 p Presented at the 1991 Institute of Electrical and Electronics Engineers (IEEE) Particle Accelerator Conference (PAC), San Francisco, CA, 6-9 May 1991
(Contract DE-AC03-76SF-00098)
(DE91-016266; LBL-30029; HIFAN-482; CONF-910505-388)
Avail: NTIS HC/MF A01

Since 1985 the Heavy Ion Fusion Accelerator Research program at the Lawrence Berkeley Laboratory has been studying current amplification and emittance variations in MBE-4, a four cesium beam induction linac. This experiment models much of the accelerator physics of the electrostatically focused section of a fusion driver. Four space charge dominated Cs(+) beams, initially about one meter in length at currents of 5 to 10 mA, are focused by electrostatic quadrupoles and accelerated in parallel from approx. 200 keV up to one MeV by 24 accelerating gaps. Final currents of 20 to 40 mA per beam are typical. Recent experiments with extremely low emittance beams (epsilon sub n) = 0.03 mm mRad have investigated variations of transverse and longitudinal normalized emittance for drifting and accelerating beams. These very strongly tune depressed beams (sigma sub o) = 72 degs, (sigma approx. 6 deg) are difficult to match the accelerator so as to avoid emittance growth during acceleration. During transport strong emittance fluctuations are observed in good qualitative agreement with simulations. Warmer beams with less tune depression exhibit little to no emittance growth, show smaller emittance fluctuations, and are much easier to match. A summary of findings from the MBE-4 studies is presented. DOE

**N91-32910#** Stanford Linear Accelerator Center, CA.
**THE COMPARISON AND SELECTION OF PROGRAMMING LANGUAGES FOR HIGH ENERGY PHYSICS APPLICATIONS**
B. White Jun. 1991 26 p Presented at the International Workshop on Software Engineering, Artificial Intelligence, and Expert Systems for High Energy and Nuclear Physics, Lyon (France), 19-24 Mar. 1990
(Contract DE-AC03-76SF-00515)
(DE91-017130; SU-SLAC-TN-91-6; CONF-900388-5) Avail: NTIS HC/MF A03

This paper discusses the issues surrounding the comparison and selection of a programming language to be used in high energy physics software applications. The evaluation method used was specifically devised to address the issues of particular importance to high energy physics (HEP) applications, not just the technical features of the languages considered. The method assumes a knowledge of the requirements of current HEP applications, the data-processing environments expected to support these applications and relevant non-technical issues. The languages evaluated were Ada, C, FORTRAN 77, FORTRAN 99 (formerly 8X), Pascal and PL/1. Particular emphasis is placed upon the past, present and anticipated future role of FORTRAN in HEP software applications. Upon examination of the technical and practical issues, conclusions are reached and some recommendations are made regarding the role of FORTRAN and other programming languages in the current and future development of HEP software. DOE

**N91-32911#** Lawrence Livermore National Lab., CA.
**INFRASTRUCTURE FOR THULIUM-170 ISOTOPE POWER SYSTEMS FOR AUTONOMOUS UNDERWATER VEHICLE FLEETS**
C. E. Walter Jul. 1991 10 p Presented at the 7th International Symposium on Unmanned Untethered Submersible Technology, Durham, NH, 23-25 Sep. 1991
(Contract W-7405-eng-48)
(DE91-017464; UCRL-JC-107583; CONF-9109242-1) Avail: NTIS HC/MF A02

The radioisotope thulium-170 is a safe and environmentally benign heat source for providing the high endurance and energy densities needed by advanced power systems for autonomous underwater vehicles (AUV). Thulium Isotope Power (TIP) systems have an endurance of approximately 3000 h, and gravimetric and volumetric energy densities of 3 times 10(exp 4) Wh/kg and 3 times 10(exp 8) Wh/cu m, respectively. These energy densities are more than 200 times higher than those currently provided by Ag-Zn battery technology. In order to capitalize on these performance levels with about one hundred AUVs in continuous use, it will be necessary to establish an infrastructure for isotope production and heat-source refurbishment. The infrastructure cost is not trivial, and studies are needed to determine its optimum configuration. The major component of the projected infrastructure is the nuclear reactor used to produce Tm- 170 by neutron absorption in Tm-169. The reactor design should ideally be

optimized for TM-170 production. Using the byproduct waste heat beneficially would help defray the cost of isotope production. However, generating electric power with the reactor would compromise both the cost of electricity and the isotope production capacity. A coastal location for the reactor would be most convenient from end-use considerations, and the waste heat could be used to desalinate seawater in water-thirsty states. DOE

**N91-32912#** Los Alamos National Lab., NM.
**REVIEW OF THE HEAVY ION PHYSICS SESSIONS**
B. V. Jacak 1991 7 p Presented at the 14th International Radiocarbon Conference, Tucson, AZ, 20-24 May 1991
(Contract W-7405-eng-36)
(DE91-017828; LA-UR-91-2846; CONF-9105225-3) Avail: NTIS HC/MF A02

The parallel sessions on Heavy Ion Physics covered several areas of recent progress in characterizing the nuclear equation of state and the search for deconfined quark matter. Studies of systems from 1 to several hundred GeV/nucleon have been made in order to map the behavior of nuclear matter over a wide range of temperatures and pressures. We have also considered results from proton-nucleus reactions in the heavy ion physics discussions. This should help untangle nuclear effects due to the presence of relatively undisturbed nuclear matter from observables arising in the hot, dense part of the system. Even though heavy ion physics covers a large range of bombarding energies, the same two basic questions must be answered. The first problem is to characterize the system that has been produced. We need to determine the energy density, lifetime, temperature and baryon density reached in the collision before expansion and particle production. Then we may address the second issue and look for evidence of new physics. At this meeting, we heard new results from experiments, and theoretical analyses which strive to explain all available data, including those from proton-nucleus collisions. We explored heavy quark production, which may indicate quark matter through color screening of c(bar c) pairs. We heard new results in strangeness production, which has been predicted to be enhanced if quark matter is formed. There were also discussions of jets and minijets, which may probe the hot, dense matter existing early in the collision. DOE

**N91-32913#** National Inst. for Fusion Science, Nagoya (Japan).
**CALIBRATION SOURCE FOR ELECTRON CYCLOTRON EMISSION MEASUREMENTS**
Kazuo Kawahata, Mizuki Sakamoto, Junji Fujita, Hiroshi Matsuo, and Kiyomi Sakai (Osaka Univ., Suita, Japan ) Feb. 1991 23 p
(NIFS-19; ISSN-0915-633X) Avail: NTIS HC/MF A03

A high temperature radiation source was developed for the absolute calibration of diagnostic instruments for measuring electron cyclotron emission from high temperature plasmas. The source has a radiation area of 150 mm and can be heated up to 500 C. The measured emissivity of the source is close to unity in the wavelength region between 0.5 and 5 mm. The grating polychrometer was calibrated using the radiation source developed. The obtained temperatures agree with those obtained by the pulse height analysis of soft x-rays and Thomson scattering measurement within 10 percent. Author

# 74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

**N91-32914#** Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
**BEAM OPTICS OF THE AmPS EXTRACTION LINE**
R. Hoekstra 15 Jan. 1991 30 p
(NIKHEF-K/AmPS/91-01; ETN-91-90046) Avail: NTIS HC/MF A03

The beam optics of the AmPS (Amsterdam Pulse Stretcher) are described. Definitions are outlined, and the beam elements and parameters are given. Developments relating to the electrostatic septum, chicane, beam transformer and bending through 90 degrees are described. The performance of the AmPS and beam diagnostics are discussed. ESA

**N91-32915#** California Univ., Berkeley. Lawrence Berkeley Lab.
**CIRCULAR INTENSITY DIFFERENTIAL SCATTERING (CIDS) MEASUREMENTS IN THE SOFT X RAY REGION OF THE SPECTRUM (APPROXIMATELY 16 eV TO 500 eV)**
M. F. Maestre, C. Bustamante, P. Snyder, E. Rowe, and R. Hansen (Synchrotron Radiation Center, Stoughton, WI.) Mar. 1991 9 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract DE-AC03-76SF-00098)
(DE91-016429; LBL-30920; CONF-9107115-24) Avail: NTIS HC/MF A02

We propose the use of recently developed techniques of circular intensity differential scattering (CIDS), as extended to the soft x-ray region of the spectrum (16 eV to 500 eV), to study the higher order organization of the eukaryotic chromosome. CIDS is the difference in scattering power of an object when illuminated by right circularly polarized vs. left circularly polarized electromagnetic radiation of arbitrary wavelength. CIDS has been shown to be a very sensitive measure of the helical organization of the scattering object, e.g., the eukaryotic chromosome. Preliminary results of measurements of samples of bacteriophages and octopus sperm done at SRC, Wisconsin, show the technique to be very sensitive to the dimensional parameters of the particles interrogated by circularly polarized light. DOE

**N91-32916#** Lawrence Livermore National Lab., CA.
**DISTORTION FREE PROJECTION LITHOGRAPHY**
A. M. Hawryluk, N. M. Ceglio, D. W. Phillion, and D. P. Gaines Jul. 1991 15 p Presented at the International Symposium on Electron, Ion and Photon Beams, Seattle, WA, 28-31 May 1991
(Contract W-7405-eng-48)
(DE91-016570; UCRL-JC-107889; CONF-9105114-1) Avail: NTIS HC/MF A03

Soft x-ray projection lithography (SXPL) may be used to fabricate high resolution structures for future devices, but will require an all-reflecting optical system with approximately 100 nm resolution and less than 10 nm image distortion over large fields-of-view. In present designs, the lithographic tool for SXPL is envisioned as a ring-field scanning system with multiple (3 to 5), possibly aspheric, imaging optics fabricated to approximately less than 1 nm figure precision. In its present form, several technologies must be developed before this tool can become practical. A simple, non-scanning optical system with less expensive optics, reduced mirror reflection losses and lower source power requirements would be very attractive. We have developed a technique, called Encoded Mask Lithography (EML), which allows for distortion free, high resolution reticle replication over a large field-of-view while using an imaging system with substantial inherent distortion. When applied to SXPL, EML allows us to use a simple, two spherical mirror imaging system. The simplified optical system used in EML eases optic fabrication requirements, obviates the need for mask-to-wafer scanning, and decreases multilayer mirror reflection losses and source power requirements. Although developed for SXPL, this concept is applicable to all forms of projection lithography where distortion over large fields may be a problem. DOE

**N91-32917#** Lawrence Livermore National Lab., CA.
**THE SURFACE MORPHOLOGY OF AS-DEPOSITED AND LASER-DAMAGED DIELECTRIC MIRROR COATINGS STUDIED IN SITU BY ATOMIC FORCE MICROSCOPY**
M. R. Kozlowski, M. Balooch, R. Tench, and W. Siekhaus 24 Jul. 1991 13 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-48)
(DE91-016571; UCRL-JC-108077; CONF-9107115-21) Avail: NTIS HC/MF A03

Atomic force microscopy was used to determine in situ the nm-scale morphological changes that occur on dielectric optical coatings as a result of laser-induced damage. The optical film studied was a highly reflective dielectric multilayer mirror (HR) consisting of many alternating HfO2 and SiO2 layers of quarter-wave thickness at 1.06 microns. The top layer was a lambda/2 SiO2 overcoat. Laser beam specifications were: 1.06 microns wavelength, 8 ns pulselength, and 110 to 300 microns beam diameter. The laser fluence was determined by beam profiling and total energy measurements. The maximum scan-range of the AFM was 80 microns. A survey of the as-deposited surface shows mostly hillocks of approximately 200 nm width and 10 nm height. Comparison of this hillock structure to that of a single layer of SiO2 and a surface layer of HfO2 was made. Irregularities (i.e., defects) on the surface of the HR consisted of micron-scale domes, and occasional craters, of micron planar dimension and depth extending over many layers. Three types of coating defects were identified which could be related to the classic nodule-type coating defect. Nodule defects were found to be easily ejected from the coating surface by laser illumination, leaving craters from which further damage would propagate. After laser damage with fluences above 30 J/sq cm the hillocks coalesced into structures with heights and widths 5 to 10 times that of the as-deposited film. A pattern of concentric surface distortions appeared at higher fluences, in some cases following the full circumference of the beam. DOE

**N91-32918#** Lawrence Livermore National Lab., CA.
**WAFER COST ANALYSIS FOR A SOFT X RAY PROJECTION LITHOGRAPHY SYSTEM**
N. M. Ceglio and A. M. Hawryluk Jul. 1991 22 p Presented at the International Symposium on Electron, Ion, and Photon Beams, Seattle, WA, 28-31 May 1991
(Contract W-7405-eng-48)
(DE91-016605; UCRL-JC-107888; CONF-9105114-2) Avail: NTIS HC/MF A03

We present a baseline analysis of issues affecting the economic viability of Soft X-ray Projection Lithography (SXPL). This analysis is intended to serve as a starting point, and provide an initial assessment of the relative importance of cost factors in a SXPL system. We presume a conventional SXPL system design and focus on wafer exposure costs. A baseline model for system component costs and performance specifications is presented, and the dependence of wafer exposure cost on elements of the model is analyzed. Within the guidelines of our model, we find that direct cost items (e.g., cost of the laser driver) are not nearly as critical as technical performance parameters (e.g., mirror reflectivity) in determining wafer exposure costs. DOE

**N91-32919#** Lawrence Livermore National Lab., CA.
**FABRICATION OF ADVANCED X RAY OPTICS WITH MAGNETRON MINI-SOURCE ARRAYS**
A. F. Jankowski, R. J. Foreman, and D. M. Makowiecki Jun. 1991 8 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-48)
(DE91-017093; UCRL-JC-105883; CONF-9107115-31) Avail: NTIS HC/MF A02

A process for direct application of multilayered coatings to large area (189 sq cm) planar or curved optical surfaces has been developed. Small diameter (2.54 cm) sputter sources are appropriately configured in an array for the deposition of multilayered coatings on virtually any optical surface. Potential application in soft x ray projection lithography is examined for the deposition of Mo/Si multilayers with a uniform, 6.5 to 7 nm layer pair spacing onto 15.2 cm diameter silicon wafers. Layer pair spacing variations less than 1.5 pct., over surface areas exceeding 120 sq cm, are measured using Cu K(alpha) grazing incidence diffraction. DOE

**N91-32920#** Brookhaven National Lab., Upton, NY.
**SOFT X RAY MAGNETIC SCATTERING STUDY OF THIN FILMS AND MULTILAYERS**
C. C. Kao, E. D. Johnson, J. B. Hastings, D. P. Siddons, and C. Vettier 1991 10 p Presented at the Spring Meeting of the Materials Research Society (MRS), Anaheim, CA, 29 Apr. - 3 May 1991
(Contract DE-AC02-76CH-00016)
(DE91-017472; BNL-46497; CONF-910406-34) Avail: NTIS HC/MF A02

A brief discussion of the resonant magnetic scattering process is given. Results from recent studies of thin Fe films and Fe/Gd multilayers are used as examples to demonstrate the information that can be obtained and the unique features of this technique: large resonant enhancement, sensitivity to magnitization, elemental specificity, and tunability of the penetration depth. Comparison is made with related techniques: magneto-optical Kerr effect, Faraday effect, and magnetic circular dichroism. DOE

**N91-32921#** Los Alamos National Lab., NM.
**RADIATION-INDUCED ATTENUATION OF HIGH-OH OPTICAL FIBERS AFTER HYDROGEN TREATMENT IN THE PRESENCE OF IONIZING RADIATION**
P. B. Lyons and L. D. Looney 1991 6 p Presented at the RADECS 1991: Radiation Effects on Components and Systems, Montpellier (France), 9-12 Sep. 1991
(Contract W-7405-eng-36)
(DE91-016093; LA-UR-91-1123; CONF-9109232-1) Avail: NTIS HC/MF A02

High purity, high-OH, optical fibers were irradiated in a hydrogen atmosphere to explore hydrogen binding into defects created by the ionizing radiation. Significant improvements in subsequent measurements of radiation-induced attenuation were observed. DOE

**N91-32922*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**THREE DIMENSIONAL MOIRE PATTERN ALIGNMENT Patent**
Richard D. Juday, inventor (to NASA) 1 Oct. 1991 13 p Filed 28 Jun. 1990 Supersedes N91-14000 (29 - 5 p 717)
(NASA-Case-MSC-21416-1; US-Patent-5,052,807; US-Patent-Appl-SN-545177; US-Patent-Class-356-375; US-Patent-Class-356-399; Int-Patent-Class-G01B-11/00) Avail: US Patent and Trademark Office CSCL 20F

An apparatus is disclosed for determining three dimensional positioning relative to a predetermined point utilizing moire interference patterns such that the patterns are complementary when viewed on axis from the predetermined distance. Further, the invention includes means for determining rotational positioning in addition to three dimensional translational positioning.
Official Gazette of the U.S. Patent and Trademark Office

**N91-32923*#** National Aeronautics and Space Administration. Pasadena Office, CA.
**METHOD AND APPARATUS FOR PHASING SEGMENTED MIRROR ARRAYS Patent Application**
Paul K. Manhart, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 3 Mar. 1991 25 p
(Contract NAS7-918)
(NASA-Case-NPO-18095-1-CU; NAS 1.71:NPO-18095-1-CU; US-Patent-Appl-SN-665509) Avail: NTIS HC/MF A03 CSCL 20F

A method and apparatus are disclosed for edge phasing an array of segments in a segmented primary telescope mirror using white light from a far field source and starting with the inner edge of each segment in the first ring of segments. The segments are individually phased for zero piston and tilt error with respect to the edge of a reference surface in the open center position of the telescope mirror, and proceeding from ring to ring by edge phasing one edge of each segment in each subsequent ring with an edge phased. After edge phasing of all segments in the telescope mirror array has been completed, full surface phasing

can be achieved by using a conventional Shack-Hartmann technique followed by finding the RMS best fit for each segment of the mirror array. NASA

**N91-32924*#** National Aeronautics and Space Administration. Pasadena Office, CA.
**FEEDBACK CONTROLLED OPTICS WITH WAVEFRONT COMPENSATION Patent Application**
William C. Breckenridge, inventor (to NASA) and David C. Redding, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 13 May 1991 31 p
(Contract NAS7-918)
(NASA-Case-NPO-18194-1-CU; NAS 1.71:NPO-18194-1-CU; US-Patent-Appl-SN-700379) Avail: NTIS HC/MF A03 CSCL 20F

The sensitivity model of a complex optical system obtained by linear ray tracing is used to compute a control gain matrix by imposing the mathematical condition for minimizing the total wavefront error at the optical system's exit pupil. The most recent deformations or error states of the controlled segments or optical surfaces of the system are then assembled as an error vector, and the error vector is transformed by the control gain matrix to produce the exact control variables which will minimize the total wavefront error at the exit pupil of the optical system. These exact control variables are then applied to the actuators controlling the various optical surfaces in the system, causing the immediate reduction in total wavefront error observed at the exit pupil of the optical system. NASA

**N91-32925*#** National Aeronautics and Space Administration. Pasadena Office, CA.
**OPTOELECTRONIC ASSOCIATIVE MEMORY Patent Application**
Tien-Hsin Chao, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 19 Aug. 1991 17 p
(Contract NAS7-918)
(NASA-Case-NPO-18278-1-CU; NAS 1.71:NPO-18278-1-CU; US-Patent-Appl-SN-747059) Avail: NTIS HC/MF A03 CSCL 20F

An associative optical memory including an input spatial light modulator (SLM) in the form of an edge enhanced liquid crystal light valve (LCLV) and a pair of memory SLMs in the form of liquid crystal televisions (LCTVs) forms a matrix array of an input image which is cross correlated with a matrix array of stored images. The correlation product is detected and nonlinearly amplified to illuminate a replica of the stored image array to select the stored image correlating with the input image. The LCLV is edge enhanced by reducing the bias frequency and voltage and rotating its orientation. The edge enhancement and nonlinearity of the photodetection improves the orthogonality of the stored image. The illumination of the replicate stored image provides a clean stored image, uncontaminated by the image comparison process. NASA

**N91-32926*#** National Aeronautics and Space Administration. Pasadena Office, CA.
**INTEGRATED FILTER AND DETECTOR ARRAY FOR SPECTRAL IMAGING Patent Application**
Clayton C. LaBaw, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 12 Aug. 1991 23 p
(Contract NAS7-918)
(NASA-Case-NPO-18317-1-CU; NAS 1.71:NPO-18317-1-CU; US-Patent-Appl-SN-744197) Avail: NTIS HC/MF A03 CSCL 20F

A spectral imaging system having an integrated filter and photodetector array is disclosed. The filter has narrow transmission bands which vary in frequency along the photodetector array. The frequency variation of the transmission bands is matched to, and aligned with, the frequency variation of a received spectral image. The filter is deposited directly on the photodetector array by a low temperature deposition process. By depositing the filter directly on the photodetector array, permanent alignment is achieved for all temperatures, spectral crosstalk is substantially eliminated, and a high signal to noise ratio is achieved. NASA

**N91-32927#** Brookhaven National Lab., Upton, NY.
**INTERACTION OF InGa LIQUID ALLOY COOLANT WITH GOLD COATED OPTICAL MATERIALS**
S. L. Hulbert 1991 16 p Presented at the 4th International Conference on Synchrotron Radiation Instrumentation, Manchester, England, 15-19 Jul. 1991
(Contract DE-AC02-76CH-00016)
(DE91-017480; BNL-46496; CONF-910730-9) Avail: NTIS HC/MF A03

A significant reaction is reported between gold surfaces and an indium-gallium eutectic liquid alloy often used to transfer heat away from optical elements in high power synchrotron radiation beamlines. This reaction proceeds at the slightly elevated temperatures (70 C) typical of conservative bakeouts used to achieve ultrahigh vacuum in the chambers which house these optical elements (mirrors, gratings, and crystals) without damaging their highly precise figure and finish. The nature and extent of this reaction is discussed, based mostly on the experience gained recently during the vacuum commissioning of two mirror chambers for a VUV wiggler-based synchrotron radiation beamline. DOE

**N91-32928#** Argonne National Lab., IL.
**COHERENT HARD X RAY FOCUSING OPTICS AND APPLICATIONS**
W. B. Yun, P. J. Viccaro, J. Chrzas, and B. Lai 1991 15 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-017968; ANL/CP-72553; CONF-9107115-41) Avail: NTIS HC/MF A03

Coherent hard x ray beams with a flux exceeding 10(exp 9) photons/second with a bandwidth of 0.1 pct. will be provided by the undulator at the third generation synchrotron radiation sources such as APS, ESRF, and Spring-8. The availability of such high flux coherent x ray beams offers excellent opportunities for extending the coherence based techniques developed in the visible and soft x ray part of the electromagnetic spectrum to the hard x rays. These x ray techniques (e.g., diffraction limited microfocusing, holography, interferometry, phase contrast imaging and signal enhancement), may offer substantial advantages over noncoherence based x ray techniques currently used. For example, the signal enhancement technique may be used to enhance an anomalous x ray or magnetic x ray scattering signal by several orders of magnitude. Coherent x rays can be focused to a very small (diffraction limited) spot size, thus allowing high spatial resolution microprobes to be constructed. The paper will discuss the feasibility of the extension of some coherence-based techniques to the hard x ray range and the significant progress that has been made in the development of diffraction limited focusing optics. Specific experimental results for a transmission Fresnel phase zone plate that can focus 8.2 keV x rays to a spot size of about 2 microns will be briefly discussed. The comparison of measured focusing efficiency of the zone plate with that calculated will be made. Some specific applications of zone plates as coherent x ray optics will be discussed. DOE

**N91-32314#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
**TEST ON OPTO COUPLERS IN THE LINEAR APPLICATION CONSIDERING TEMPERATURE, RADIATION AND Vce EFFECTS**
H. Spruijt, K. Burrows, J. Andersen, S. Marsden, and J. Tilmant (Etudes Techniques et Constructions Aerospatiales, Charleroi, Belgium ) *In its* ESA Electronic Components Conference Mar. 1991 p 159-164 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

# 75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**N91-32929#** National Inst. for Fusion Science, Nagoya (Japan).
**MACROSCALE IMPLICIT, ELECTROMAGNETIC PARTICLE SIMULATION OF INHOMOGENEOUS AND MAGNETIZED PLASMAS IN MULTI-DIMENSIONS**
M. Tanaka, S. Murakami, H. Takamaru (Hiroshima Univ., Japan ), and T. Sato Jun. 1991 38 p
(NIFS-91; ISSN-0915-633X) Avail: NTIS HC/MF A03

An implicit, electromagnetic particle (kinetic) simulation method is presented that can deal with multi-dimensional, inhomogeneous and finite beta plasmas in large space and time scales. To include the diamagnetic effects in strongly magnetized and inhomogeneous, kinetic plasmas of the large scales, full implicit directly-coupled field-particle equations are derived by using the backward time-decentered scheme and the guiding center approximation with the magnetic drifts about the electron perpendicular motion. This algorithm was implemented for studies of inhomogeneous and magnetized plasmas of three dimensions. The basic algorithm of the code is described and several physics applications are shown for the Alfven-ion-cyclotron instability and kink instability of the peaked density ion beam. Author

**N91-32930#** National Inst. for Fusion Science, Nagoya (Japan).
**H-MODE PHYSICS: EXPERIMENTAL OBSERVATIONS AND MODEL THEORIES. LECTURE NOTES**
Sanae-I. Itoh Jun. 1991 62 p Presented at a Lecture on Plasma Physics, Trieste, Italy, 27 May - 21 Jun. 1991
(NIFS-92; ISSN-0915-633X) Avail: NTIS HC/MF A04

After the discovery of the H-mode in ASDEX, the transition between the L-mode and H-mode was observed in many tokamaks in the world. The H-mode made a breakthrough in improving the plasma parameters and was recognized to be a universal phenomena. Since its discovery, the extensive studies both in experiments and in theory were made. The research on H-mode was casting new problems of anomalous transport across the magnetic surface. The series of lectures is presented which will provide a brief review of experiments for explaining H-mode and a model theory of H-mode transition based on the electric field bifurcation. Author

**N91-32931#** National Inst. for Fusion Science, Nagoya (Japan).
**GEOMETRIC DEPENDENCE OF THE SCALING LAW ON THE ENERGY CONFINEMENT TIME IN H-MODE DISCHARGES**
Y. Miura, Kimitaka Itoh, Sanae-I. Itoh, T. Takizuka, H. Tamai, T. Matsuda, N. Suzuki, M. Mori, H. Maeda, and O. Kardaun (Max-Planck-Inst. fuer Plasmaphysik, Garching, Germany, F.R. ) Jun. 1991 20 p
(NIFS-93; ISSN-0915-633X) Avail: NTIS HC/MF A03

The dependence of the energy confinement time tau(sub E) in the H-mode discharges on the plasma elongation and divertor configurations is studied. Regression analysis is made on the H-mode database, while the dependence on the closed/open divertor is introduced according to the ASDEX experiments. The dependence of tau(sub E) on the elongation factor kappa was found to be positive (approximately kappa(exp 0.8)) for the ELM free H-mode, confirming the experiments on kappa-dependence in JFT-2M tokamaks. The influence of the single/double null divertor configuration is also discussed. Author

**N91-32932#** National Inst. for Fusion Science, Nagoya (Japan).
**ELMy-H MODE AS LIMIT CYCLE AND CHAOTIC OSCILLATIONS IN TOKAMAK PLASMAS**
Sanae-I. Itoh, Kimitaka Itoh, and Atsushi Fukuyama (Okayama Univ., Japan ) Jun. 1991 82 p
(NIFS-96; ISSN-0915-633X) Avail: NTIS HC/MF A05

A model of Edge Localized Modes (ELMs) in tokamaks is presented. A limit cycle solution is found in time dependent Ginzburg Landau type model equation of L/H transition, which has a hysteresis curve between the plasma gradient and flux. The oscillation of edge density appears near the L/H transition boundary. Spatial structure of the intermediate state (mesophase) is obtained in the edge region. Chaotic oscillation is predicted due to random neutrals and external oscillations. Author

**N91-32933#** National Inst. for Fusion Science, Nagoya (Japan).
**AN H-MODE-LIKE BIFURCATION IN CORE PLASMA OF STELLARATORS**
Kimitaka Itoh, Sanae-I. Itoh, H. Sanuki, and Atsushi Fukuyama (Okayama Univ., Japan ) Jun. 1991 22 p
(NIFS-97; ISSN-0915-633X) Avail: NTIS HC/MF A03

The radial electric field, reduction of anomalous transport, and ion temperature profile are simultaneously analyzed in the Wendelstein-VIIA (W VII-A) stellarators. Neoclassical formula is used to determine the radial electric field. Bifurcation of the anomalous transport is found at a critical injection power, above which improved confinement is possible. Experimental results of W VII-A, which have shown the sharp reduction of the H sub alpha signal after the injection of the neutral beam, are revisited. Author

**N91-32934#** National Inst. for Fusion Science, Nagoya (Japan).
**AXIAL PRESSURE PROFILE EFFECTS ON FLUTE INTERCHANGE STABILITY IN THE TANDEM MIRROR GAMMA 10**
Hitoshi Hojo, Tsuguhiro Watanabe, Masaaki Inutake, Makoto Ichimura, and Syoichi Miyoshi (Tsukuba Univ., Japan ) Jun. 1991 18 p
(NIFS-98; ISSN-0915-633X) Avail: NTIS HC/MF A03

Flute interchange stability of the tandem mirror GAMMA 10 with a minimum-B MHD anchor is studied numerically. The stability criterion in beta value is obtained and its axial pressure profile dependence is also analyzed. It is shown that the anchor beta value for stability is reduced when the axial localization of a mirror trapped hot plasma becomes narrower in the central cell and/or in the anchor cell. Author

**N91-32935#** InterScience, Inc., Troy, NY.
**HEAVY NEUTRAL BEAM PROBE FOR EDGE PLASMA ANALYSIS IN TOKAMAKS**
19 Jul. 1991 25 p
(Contract DE-FG02-91ER-54111)
(DE91-016290; DOE/ER-54111/1) Avail: NTIS HC/MF A03

The Heavy Neutral Beam Probe project presented in this document is part of an international collaboration in magnetic confinement fusion energy research sponsored by the U.S. Department of Energy, Office of Energy Research (Confinement Systems Division) and the Centre Canadian de Fusion Magnetique. The overall objective of the effort is to apply a neutral particle beam to the study of edge plasma dynamics in discharges on the Tokamak de Varennes facility in Montreal, Canada. To achieve this goal, a research and development project was started in December, 1990 to produce the necessary hardware to make such measurements and meet the scheduling requirements of the program. At present, satisfactory progress has been achieved. The ion gun is fully operational with the neutralizer in the final assembly stage in preparation for testing. The beam diagnostics have been completed and mounted in the computer automated test stand. The analyzer design and detailed trajectory calculations are nearing completion to allow for the vacuum interface construction. The CAMAC based data acquisition system hardware was integrated into the test stand. Part of this hardware is a component of the Tokamak de Varennes' contribution to the collaboration. Next steps on the critical path include the beginning of the neutralization tests and the start of the analyzer construction. Anticipated installation of the diagnostic on the tokamak is Spring 1992. DOE

**N91-32936#** Los Alamos National Lab., NM.
**FURTHER DEVELOPMENT OF IDGS: ISOTOPE DILUTION GAMMA-RAY SPECTROMETRY**
T. K. Li, J. L. Parker, Y. Kuno, S. Sato, M. Kamata, and T. Akiyama 1991 8 p Presented at the 32nd Institute of Nuclear

Materials Management Annual Meeting, New Orleans, LA, 28-31 Jul. 1991
(Contract W-7405-eng-36)
(DE91-016315; LA-UR-91-2509; CONF-910774-65) Avail: NTIS HC/MF A02

The isotope dilution gamma-ray spectrometry (IDGS) technique for determining the plutonium concentration and isotopic composition of highly radioactive spent-fuel dissolver solutions has been further developed. Both the sample preparation and the analysis have been improved. The plutonium isotopic analysis is based on high-resolution, low-energy gamma-ray spectrometry. The plutonium concentration in the dissolver solutions then is calculated from the measured isotopic differences among the spike, the dissolver solution, and the spiked dissolver solution. Plutonium concentrations and isotopic compositions of dissolver solutions analyzed from this study agree well with those obtained by traditional isotope dilution mass spectrometry (IDMS) and are consistent with the first IDGS experimental result. With the current detector efficiency, sample size, and a 100-min count time, the estimated precision is approximately 0.5 percent for Pu-239 and Pu-240 isotopic analyses and approximately 1 percent for the plutonium concentration analysis. DOE

**N91-32937#** Los Alamos National Lab., NM.
**THE PROMISE OF MAGNETIZED FUEL: HIGH GAIN IN INERTIAL CONFINEMENT FUSION**
I. R. Lindemuth and R. C. Kirkpatrick 1991 5 p Presented at the 6th International Conference on Emerging Nuclear Energy Systems, Monterey, CA, 16-21 Jun. 1991
(Contract W-7405-eng-36)
(DE91-016321; LA-UR-91-2498; CONF-910626-3) Avail: NTIS HC/MF A01

At the third International Conference on Emerging Nuclear Energy Systems, we presented computational results which suggested that breakeven experiments in inertial confinement fusion (ICF) may be possible with existing driver technology. Our computations used a simple zero-dimensional model to survey the parameter space available for magnetized fuel. The survey predicted the existence of a totally new region in parameter space where significant thermonuclear fuel burn-up can occur. The new region is quite remoted from conventional parameter space and is characterized by very low fuel densities, very low implosion velocities, and, most importantly, driver requirements reduced by orders of magnitude. Whereas our initial computations considered only the yield from a hot, magnetized central fuel, we have extended our simple model to include a cold fuel layer. In the same spirit as our earlier work, our extended model is intended to provide a starting point for more comprehensive investigations. Our extended model predicts that it is possible to obtain a large cold fuel burn-up fraction, leading to very high gain, and once again, the optimum parameter space is quite remote from that of conventional high gain targets. Although conventional drivers optimized for conventional targets are probably not optimum for magnetized fuel at its extremes, there is a continuum between the conventional parameter space and the new parameter space, suggesting a possible role for conventional drivers. However, it would appear that magnetized fuel warrants a complete rethinking of the entire driver/target configuration. DOE

**N91-32938#** Los Alamos National Lab., NM.
**A NEW VARIATIONAL FORMULATION OF KINETIC PLASMA THEORY AND THE APPLICATION OF MOVING FINITE ELEMENTS**
A. H. Glasser 1991 4 p Presented at the 14th Conference on Numerical Simulation of Plasmas, Annapolis, MD, 4-6 Sep. 1991
(Contract W-7405-eng-36)
(DE91-016072; LA-UR-91-2242; CONF-9109108-6) Avail: NTIS HC/MF A01

A new variational formulation has been developed for the system of equations governing kinetic plasmas and electromagnetic fields. It is used to apply the method of Moving Finite Elements to the electromagnetic fields. The fields are expanded in a basis of linear finite elements on a movable, unstructured grid of triangles in 2D or tetrahedra in 3D, while the plasma distribution function is expanded in a basis of super particles. Minimization of the variational with respect to the time derivatives of the field quantities yields a coupled system of equations for simultaneously advancing the amplitudes and node positions, resulting in adaptive grid motion. The adaptivity of the grid may save a large factor in the size of the grid and the number of particles required in many problems. Minimization of the variational with respect to the time derivatives of the particle positions and velocities gives the equations of motion, providing consistent prescriptions for assigning particles to the grid and fields to the particles. Orthogonality conditions on the particles are derived as conditions for keeping their equations of motion independent. Collisions can be included in a natural way. The relationship between PIC methods and alternative methods of discretizing phase space is clarified. DOE

**N91-32939#** Montana State Univ., Bozeman. Dept. of Mechanical Engineering.
**CORROSION AND ARC EROSION IN MHD CHANNELS**
R. J. Rosa and R. J. Pollina Apr. 1991 9 p
(Contract DE-FG22-88PC-88928)
(DE91-016829; DOE/PC-88928/T4) Avail: NTIS HC/MF A02

The objective of this task is to study the corrosion and arc erosion of MHD materials in a cooperative effort with, and to support, the MHD topping cycle program. Materials tested in the Avco Research Laboratory/Textron facility, or materials which have significant MHD importance, will be analyzed to document their physical deterioration. Conclusions shall be drawn about their wear mechanisms and lifetime in the MHD environment with respect to the following issues; sulfur corrosion, electrochemical corrosion, and arc erosion. The impact of any materials or slag conditions on the level of power output and on the level of leakage current in the MHD channel will also be noted, where appropriate. Two phenomena that can effect the analysis of slag leakage current have been investigated and found significant. These are: (1) transverse current along the slag layer in the insulator walls of an MHD duct, and (2) electrode surface voltage drops. Both tend to reduce the value inferred for average plasma conductivity and increase the value inferred for axial leakage current. These two effects in combination are potentially capable of explaining the high leakage inferred. Corrosion on the water side of metal MHD duct wall elements has been examined in CDIF and Mark 7 generators. It appears to be controllable by adjusting the pH of the water and/or by controlling the dissolved oxygen content. DOE

**N91-32940#** Lawrence Livermore National Lab., CA.
**L TO H MODE TRANSITIONS AND ASSOCIATED PHENOMENA IN DIVERTOR TOKAMAKS**
A. Punjabi (Hampton Inst., VA.) Sep. 1990 6 p
(Contract W-7405-eng-48)
(DE91-017074; UCRL-CR-107988) Avail: NTIS HC/MF A02

This is the final report for the research project titled, L to H Mode Transitions and Associated Phenomena in Divertor Tokamaks. The period covered by this project is the fiscal year 1990. This report covers the development of Advanced Two Chamber Model. DOE

**N91-32941#** Fusion Physics and Technologies, Torrance, CA.
**ADVANCED FUSION DIAGNOSTICS**
30 Jul. 1991 7 p
(Contract DE-FG03-90ER-54089)
(DE91-017412; DOE/ER-54089/1) Avail: NTIS HC/MF A02

This research program is divided into two diagnostic development projects: Task 1. charged fusion product diagnostics by spectral analysis of ioncyclotron emission; and Task 2. safety factor, q(r) measurements, a study of transport in the PBX-M tokamak plasma. DOE

**N91-32942#** Sandia National Labs., Albuquerque, NM.
**INTENSE ION BEAM DIAGNOSTICS FOR LIGHT ION INERTIAL FUSION EXPERIMENTS ON PBFA 2**

R. J. Leeper, W. A. Stygar, J. E. Bailey, G. T. Baldwin, D. D. Bloomquist, A. L. Carlson, G. Chandler, C. E. Crist, G. Cooper, and M. S. Derszon et al 1991 8 p Presented at the International School of Plasma Physics Piero Caldirola' Diagnostics for Contemporary Fusion Experiments, Varenna, Italy, 27 Aug. - 6 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE91-017449; SAND-91-1019C; CONF-910857-2) Avail: NTIS HC/MF A02

A review of recent developments in intense ion beam diagnostics used in the light ion inertial confinement fusion (ICF) program on the PBFA-2 accelerator at Sandia National Laboratories will be presented. These developments have occurred in each of several generic classes of diagnostics, namely, imaging diagnostics, particle spectrograph diagnostics, nuclear activation, and visible spectroscopy. Critical beam parameters measured by the diagnostic include spatial profile, absolute number, species, anode plasma temperature and density, beam divergence, and beam voltage current density, and power density. A unique feature of these diagnostics is that they are capable of operating in hard (multi-Mev) X ray (bremsstrahlung) backgrounds of some 10(exp 10) to 10(exp 12) rad/s. The operating principles of each diagnostic will be summarized in the paper, with examples of how the diagnostics may be integrated together to form a complete diagnostic system. The paper will close with a discussion of several near diagnostic systems that are presently being developed. DOE

**N91-32943#** Ames Lab., IA.
**ALLEVIATION OF INTERFERENCES AND REDUCTION OF SAMPLE MEMORY IN INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY Ph.D. Thesis**
F. G. Smith 27 Jun. 1991 120 p
(Contract W-7405-eng-82)
(DE91-016399; IS-T-1552) Avail: NTIS HC/MF A06

A simple variation sample preparation and introduction allows the measurement of chlorine isotope ratios by inductively coupled plasma mass spectroscopy (ICP-MS). Dissolution of the sample in D2O rather than H2O attenuates the major polyatomic ion (36)ArH(+) and frees m/z = 37 for determination of (37)Cl(+). The isotope ratio (35)Cl/(37)Cl in a 50 mg/L solution of Cl as LiCl is determined with a relative standard deviation (RDS) of 0.21 pct. A method for the determination of boron is a variety of biological samples is described. Sample material is fused with Na2CO3 and boron is separated from matrix components by using Amberlite IRA-743 boron selective ion exchange resin. Boron is eluted with 1 pct. HNO3 and samples are introduced to an ICP mass spectrometer with a direct injection nebulizer (DIN). Xenon is added at 10 or 37 mL/min to the aerosol gas flow of an argon ICP mass spectrometer. Addition of Xe substantially reduces polyatomic ions such as N2(+), HN2(+), NO(+), ArH(+), ClO(+), ArC(+), ClOH(+), ArN(+), and ArO(+) and facilitates the measurement of Si, K, V, Cr, and Fe. Isotope ratios are determined with RSDs from 0.6 to 1.6 pct. DOE

**N91-32944#** Sandia National Labs., Albuquerque, NM.
**GRAPHITE-METAL BRAZING FOR THERMAL APPLICATIONS**
F. M. Hosking and J. A. Koski 1991 24 p Presented at the Fall Meeting of the Minerals, Metals, and Materials Society of AIME and Materials Week of the American Society of Metals, Cincinnati, OH, 20-24 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016647; SAND-90-3213C; CONF-911003-5) Avail: NTIS HC/MF A03

Various plasma facing components are being designed and fabricated to support Magnetic Fusion Energy experiments. They typically consist of graphite tiles mechanically or metallurgically attached to metallic cooling substrates. This paper will discuss the active brazing of isotropic and pyrolytic graphite to oxygen free, high conductivity (OFHC) Cu and an alumina-dispersion strengthened Cu with a Ag-Cu-Ti active filler metal. The Ti constituent promotes direct wetting of graphite with the formation of a thin TiC reaction layer. Joint design and materials selection are critical factors since graphite and Cu have large thermal expansion differences that affect residual stresses after brazing and subsequent component thermal performance. Low thermal expansion Mo and compliant Cu interlayers were introduced to lower the residual stresses and extend the thermal life of prototype graphite-Cu braze joints. Although the interlayers showed evidence of reducing the incidence of graphite cracking and spalling under thermal loading when brazed to the dispersion stengthened Cu, the best graphite braze joints were produced with the more ductile OFHC Cu substrates and no interlayer. These latter joints survived simulated tokamak surface high heat fluxes of 30 MW x m(exp -2) or greater, while comparable dispersion strengthened Cu samples failed at 10 MW x m(exp -2) DOE

**N91-32945#** Texas Univ., Austin. Inst. for Fusion Studies.
**EXCITATION OF NONLINEAR WAKE FIELD IN A PLASMA FOR PARTICLE ACCELERATION**
B. N. Breizman, P. Z. Chebotaev (Academy of Sciences, USSR, Novosibirsk ), D. L. Fisher, and T. Tajima Jun. 1991 28 p
(Contract DE-FG05-80ET-53088)
(DE91-017386; DOE/ET-53088/502; IFSR-502) Avail: NTIS HC/MF A03

Excitation of large amplitude wake fields in a plasma for acceleration of particles is theoretically and computationally considered. The wake electric field can be generated either by short laser pulses or charged particle (electrons) beam pulses. We treat both cases from a unified point of view and compare them. In two (or three) dimensional investigations, the wake causing agencies are treated as rigid, while in the one dimensional cases the feedback of the wake field on the driving pulse is fully accounted for both kinetically and relativistically. We elucidate on transverse and longitudinal wavebreaking effects, nonlinear wake field effects, pulse shaping, multiple pulses, the coherency length of wake fields, and on the comparison of laser and electron beam pulses. DOE

**N91-32946#** Texas Univ., Austin. Inst. for Fusion Studies.
**KINETIC THEORY OF RF CURRENT DRIVE AND HELICITY INJECTION**
R. R. Mett 11 Jul. 1991 23 p
(Contract DE-FG05-80ET-53088)
(DE91-017388; DOE/ET-53088/508; IFSR-508) Avail: NTIS HC/MF A03

Current drive and helicity injection by plasma waves are examined with the use of kinetic theory. The Vlasov equation yields a general current drive formula which contains resonant and nonresonant contributions. Standard quasilinear current drive is described by the former, while helicity current drive may be contained in the latter. Since direct analytical comparison of the sizes of the two terms is in general difficult, a new approach is taken. Solution of the drift-kinetic equation shows that the standard Landau damping/transit time magnetic pumping quasilinear diffusion coefficient is the only contribution to steady-state current drive to leading order in var epsilon equals rho sub L/sup I, where rho sub L is the Larmor radius and I is the inhomogeneity scale length. All nonresonant contributions, including the helicity, appear at higher order, after averages are taken over a flux surface, over azimuth, and over time. Consequently, at wave frequencies well below the electron cyclotron frequency, a wave helicity flux perpendicular to the magnetic field does not influence the parallel motion of electrons to leading order and therefore will not drive a significant current. Any current associated with a wave helicity flux is then either ion current or electron current stemming from effects not included in the drift-kinetic treatment, such as cyclotron, collisional, or nonlinear. DOE

**N91-32947*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**METHOD FOR ANISOTROPIC ETCHING IN THE MANUFACTURE OF SEMICONDUCTOR DEVICES Patent Application**
Steven Koontz, inventor (to NASA) and Jon Cross, inventor (to NASA) (Los Alamos National Lab., NM.) 12 Jul. 1991 27 p
(NASA-Case-MSC-21631-1; NAS 1.71:MSC-21631-1;

US-Patent-Appl-SN-729107) Avail: NTIS HC/MF A03 CSCL 20I

Hydrocarbon polymer coatings used in microelectronic manufacturing processes are anisotropically etched by hyperthermal atomic oxygen beams (translational energies of 0.2 to 20 eV, preferably 1 to 10 eV). Etching with hyperthermal oxygen atom species obtains highly anisotropic etching with sharp boundaries between etched and mask protected areas. NASA

**N91-32948#** California Univ., Berkeley. Dept. of Physics.
**SELF-GENERATED STOCHASTIC HEATING IN AN RF DISCHARGE**
1991 8 p
(Contract DE-FG03-87ER-13727)
(DE91-017404; DOE/ER-13727/T1) Avail: NTIS HC/MF A02

We have studied the nonlinear dynamics of stochastic heating arising from the reflection of electrons from moving sheaths as an underlying mechanism for electron power deposition in RF discharges of the type used in the plasma-assisted processing of materials. We have determined the time-varying sheath motion in a plane parallel RF discharge using a Langmuir probe technique and compared the measurements to models of the nonlinear sheath motion. We find good agreement to a self-consistent analysis of the sheath motion previously developed. We have constructed a helical resonator plasma source which can be used for experimental studies of stochastic heating at low pressures for which the stochasticity is an intrinsic property of the dynamics and is not due to interparticle collisions. We have characterized the plasma density, absorbed power and helix voltage as functions of the input power and pressure. We have developed a model of the helical resonator plasma and compared this to the measurements. DOE

**N91-32949#** General Atomic Co., San Diego, CA.
**INITIAL OPERATIONAL EXPERIENCE AFTER INSTALLATION OF THE D3-D RADIATION SHIELD**
P. L. Taylor Jul. 1991 6 p
(Contract DE-AC03-89ER-51114)
(DE91-017765; GA-A-20558) Avail: NTIS HC/MF A02

The D3-D tokamak now operates with a neutron radiation shield to allow enhanced plasma operations with increased neutron production while minimizing the site boundary dose level. Neutron rates as high as 3 x 10(exp 15) neutrons/sec and total neutron production of 4 x 10(exp 15) neutrons per shot are obtained while maintaining the site dose below the DOE administrative level of 20 millirem per year; a much more restrictive level than the State of California radiation limits. The D3-D tokamak facility completed an upgrade in the spring of 1989 which included additional radiation shielding to allow more extensive operation with neutron generating deuterium beams and deuterium plasmas. The previous shielding, designed primarily as a gamma shield, consisted of 63 cm thick concrete walls to a height 3.1 m above the vessel midplane (approximately 1.7 m above the top of the plasma vessel). The additional neutron shield extended the concrete walls to a shielded roof consisting of a movable section and a fixed section. These additional shield walls are 30 cm of polyboron material while the roof is 36 cm of a water based boronated gel. DOE

**N91-32950#** Oak Ridge National Lab., TN.
**TUNING AND MATCHING OF THE BPX ICH SYSTEM**
D. W. Swain 1991 4 p Presented at the 9th Topical Conference on Radio Frequency Power in Plasmas, Charleston, SC, 12-14 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017872; CONF-910869-1) Avail: NTIS HC/MF A01

Two methods of tuning and matching the ion cyclotron heating (ICH) antennas for the Burning Plasma Experiment (BPX) to the BPX plasma have been analyzed. Both appear to provide adequate tuning and matching capabilities. However, there are trade-offs between the frequency range that can be covered and the compactness of the high-voltage region of the transmission lines that makes up of the matching network. DOE

**N91-32951#** Lawrence Livermore National Lab., CA.
**INERTIAL CONFINEMENT FUSION, VOLUME 1, NUMBER 2 Quarterly Report, Jan. - Mar. 1991**
P. E. Young, ed. 1991 54 p
(Contract W-7405-eng-48)
(DE91-017920; UCRL-LR-105821-91-2) Avail: NTIS HC/MF A04

This report discusses: damage resistant optical components; iron doped polymers for capsule implosion diagnostics; a novel perfluorinated antireflective and protective coating for KDP and other optical materials; temperature- and age-dependence of redistribution rates of frozen deuterium-tritium; characterization of the plasma switch interaction in the LBL HIF ion source; short wavelength nickel-like x ray laser development; measurement of the spatial coherence of a soft x ray laser; experimental study of filamentation in laser-plasma interactions; and measurements with a microchannnel-plate camera with 35-ps gating time. DOE

**N91-32952#** General Atomic Co., San Diego, CA.
**THE EVOLUTION OF US HELIUM-COOLED BLANKETS**
C. P. C. Wong, E. T. Cheng, and K. R. Schultz Aug. 1991 17 p Presented at the 2nd International Symposium on Nuclear Fusion Technology, Karlsruhe, Fed. Republic of Germany, 3-8 Jun. 1991
(Contract DE-AC03-89ER-52153)
(DE91-017938; GA-A-20467; CONF-910615-6) Avail: NTIS HC/MF A03

This paper reviews and compares four helium-cooled fusion reactor blanket designs. These designs represent generic configurations of using helium to cool fusion reactor blankets that were studied over the past 20 years in the United States of America. These configurations are the pressurized module design, the pressurized tube design, the solid particulate and gas mixture design, and the nested shell design. Among these four designs, the nested shell design, which was invented for the ARIES study, is the simplest in configuration and has the least number of critical issues. Both metallic and ceramic-composite structural materials can be used for this design. It is believed that the nested shell design can be the most suitable blanket confirmation for helium-cooled fusion power and experimental reactors. DOE

**N91-32953#** Los Alamos National Lab., NM.
**RADIATION HARDENING OF DIAGNOSTICS**
R. E. Siemon 1991 8 p Presented at the International School of Plasma Physics Piero Caldirola Diagnostics for Contemporary Fusion Experiments, Varenna, Italy, 27 Aug. - 6 Sep. 1991
(Contract W-7405-eng-36)
(DE91-018039; LA-UR-91-2747; CONF-910857-3) Avail: NTIS HC/MF A02

The world fusion program has advanced to the stage where it is appropriate to construct a number of devices for the purpose of burning DT fuel. In these next-generation experiments, the expected flux and fluence of 14 MeV neutrons and associated gamma rays will pose a significant challenge to the operation and diagnostics of the fusion device. Radiation effects include structural damage to materials such as vacuum windows and seals, modifications to electrical properties such as electrical conductivity and dielectric strength and impaired optical properties such as reduced transparency and luminescence of windows and fiber optics during irradiation. In preparation for construction and operation of these new facilities, the fusion diagnostics community needs to work with materials scientists to develop a better understanding of radiation effects, and to undertake a testing program aimed at developing workable solutions for this multi-faceted problem. A unique facility to help in this regard is the Los Alamos Spallation Radiation Effects Facility, a neutron source located at the beam stop of the world's most powerful accelerator, the Los Alamos Meson Physics Facility (LAMPF). The LAMPF proton beam generates 10(exp 16) neutrons per second because of spallation'reactions when the protons collide with the copper nuclei in the beam stop. DOE

**N91-32954#** National Inst. for Fusion Science, Nagoya (Japan).
**HEAT DEPOSITION ON THE PARTIAL LIMITER**
Kimitaka Itoh, K. Nagasaki (Kyoto Univ., Japan ), and Sanae-I. Itoh Apr. 1990 12 p Sponsored in part by Ministry of Education
(NIFS-28; ISSN-0915-633X) Avail: NTIS HC/MF A03

The effect of the partial limiter in the outermost magnetic surface of toroidal plasmas is studied. The power deposition on the partial limiter and its effect on the temperature profile are analyzed. Interpretation in terms of the perpendicular heat conductivity is also discussed. Author

**N91-32955#** National Inst. for Fusion Science, Nagoya (Japan).
**BEAM-DRIVEN CURRENTS IN THE 1/NU REGIME IN A HELICAL SYSTEM**
Noriyoshi Nakajima and Masao Okamoto Apr. 1990 20 p
(NIFS-27; ISSN-0915-633X) Avail: NTIS HC/MF A03

Beam currents driven by a neutral particle injection in a helical system (stellarator, heliotron/torsatron) are studied in the 1/upsilon collisionality regime. The general expression for the beam driven current is obtained for arbitrary magnetic field configurations by solving the drift kinetic equation for electrons. It is found that F = J sub net/J sub b (J sub net is the net current and J sub b is the fast ion beam current) increases as f sub t and Z sub eff where f sub t is the fraction of trapped electrons and Z sub eff approx. = 1 the effect of trapped electrons is large and F is roughly proportional to f sub t. On the other hand, if Z sub eff is approx. greater than 3, the effect of trapped electrons becomes small. Author

**N91-32956#** National Inst. for Fusion Science, Nagoya (Japan).
**EDGE ELECTRIC FIELD PROFILES OF H-MODE PLASMAS IN JFT-2M TOKAMAK**
K. Ida, S. Hidekuma, Y. Miura, T. Fujita, M. Mori, K. Hoshino, N. Suzuki, and T. Yamauchi (Japan Atomic Energy Research Inst., Ibaraki.) Apr. 1990 19 p
(NIFS-26; ISSN-0915-633X) Avail: NTIS HC/MF A03

A structure of an edge radial electric field (E sub r) inferred from poloidal rotation velocity is compared with that of particle/thermal transport barrier for H-mode plasmas in JFT-2M. Both E sub r and its gradient (delta E sub r/delta r) in the thermal transport barrier are found to become more negative at the L/H transition. The shear of radial electric field and poloidal rotation velocity in H-mode is localized within an ion poloidal gyro radius near the separatrix, in the region of ion collisionality v* sub i approx. = 10 to 40. Author

**N91-32957#** National Inst. for Fusion Science, Nagoya (Japan).
**DEVELOPMENT OF THE STELLARATOR/HELIOTRON RESEARCH**
A. Iiyoshi May 1991 30 p Original contains color illustrations
(NIFS-84; ISSN-0915-633X) Avail: NTIS HC/MF A03

Here, the author reviews the history of the development of the stellarator/heliotron system. He points out the important role of the radial electric field in plasma transport in helical devices. The author expects that the decade of the 1990's will see significant new developments for helical fusion research. Author

# 76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

**N91-32958#** California Univ., Berkeley. Lawrence Berkeley Lab. National Center for Electron Microscopy.
**OXYGEN ORDERED SUPERSTRUCTURES AND DOMAIN FORMATION IN YBa2Cu3O(7-x)**
L. T. Wille, C. P. Burmester, R. Gronsky, P. A. Sterne, B. T. Ahn, V. Y. Lee, R. Beyers, T. M. Guer, and R. A. Huggins (Stanford Univ., CA.) May 1990 6 p Presented at the ICMC 1990 Topical Symposium on High Temperature Superconductors: Materials Aspects, Garmisch-Partenkirchen, Fed. Republic of Germany, 9-11 May 1990
(Contracts DE-AC03-76SF-00098; W-7405-eng-48; MDA972-88-J-1006)
(DE90-015633; LBL-29216; CONF-900527-3) Avail: NTIS HC/MF A02

In spite of a good deal of recent effort, the thermodynamic stability and kinetics of formation of ordered O-Cu-O chains in the basal plane of YBa2Cu3O(7-x) remain unclear. Because the chain disordering is associated with the orthorhombic-to-tetragonal phase transformation and the ensuing loss of superconductivity, a fundamental understanding of the nature of the oxygen-vacancy ordering has far-reaching implications for materials preparation and optimization. In order to clarify some of these questions, we have undertaken a combined theoretical (first-principles) and experimental (HREM) study of the thermodynamic properties of the YBa2Cu3O(7-x) system. DOE

**N91-32959#** Sandia National Labs., Albuquerque, NM.
**La(SUP 139) NMR AND NQR STUDY OF THE TEMPERATURE DEPENDENT STRUCTURE OF La2CuO4+(DELTA)**
P. C. Hammel, E. T. Ahrens, A. P. Reyes, R. H. Heffner, P. C. Canfield, S-W. Cheong, Z. Fisk, and J. E. Schirber 1991 7 p Presented at the International Conference on Materials and Mechanisms of Superconductivity, Kanazawa (Japan), 22-26 Jul. 1991 Prepared in cooperation with Los Alamos National Lab., NM
(Contract DE-AC04-76DP-00789)
(DE91-016201; SAND-91-1703C; LA-UR-91-2400; CONF-910736-6) Avail: NTIS HC/MF A02

Nuclear magnetic resonance (NMR) and nuclear quadrupole resonance (NQR) reveal substantial structural changes in the metallic phase of La2Cu4(+) (delta) which occur below 220 K. The oxygen octahedra in the metallic phase are not tilted at phase separation; upon cooling to 40 K, considerable tilt has developed. The low temperature structure is highly disordered. DOE

**N91-32960#** Oak Ridge National Lab., TN.
**FORMATION AND ANNEALING BEHAVIOR OF AN AMORPHOUS LAYER INDUCED BY TIN IMPLANTATION INTO SAPPHIRE**
L. J. Romana (Oak Ridge Associated Universities, Inc., TN.), P. S. Sklad, C. W. White, A. Choudhury, L. L. Horton, and J. C. McCallum 1991 18 p Presented at the 7th International Conference on Surface Modification of Metals by Ion Beams (SMMIB-7), Washington, DC, 15-19 Jul. 1991
(Contract DE-AC05-84OR-21400)
(DE91-015929; CONF-910707-2) Avail: NTIS HC/MF A03

The formation and annealing behavior of an amorphous layer produced by tin implantation into sapphire has been studied. Tin ions with 180 keV energy were implanted into alpha-Al2O3 at 300 K with fluences ranging from 10(exp 15) to 10(exp 17) ions/sq cm. The thermal stability of the damaged layer was investigated with post-implantation annealing treatments at temperatures up to 1375 K in either oxidizing or reducing atmospheres. The atomic spatial distribution of the ions were determined by Rutherford backscattering spectroscopy (RBS) in random and channeling geometries. The structure of the implanted layer was determined by analytical electron microscopy (AEM). The degree of disorder was found to increase linearly with the fluence up to the threshold for amorphization, approx. 1 x 10(exp 16) ions/sq cm. The microstructure of the implanted layer after the thermal treatments depended on the annealing atmosphere. The well known amorphous yields gamma-Al2O3 yields alpha-Al2O3 phase transition was observed during annealing in a reducing atmosphere. However, anneals in an oxidizing environment led to the formation of the compound SnO2, which was found to stabilize the cubic gamma-Al2O3 phase. DOE

**N91-32961#** Los Alamos National Lab., NM.
**HIGH PRESSURE MOESSBAUER SPECTROSCOPY IN DIAMOND ANVIL CELLS**
R. D. Taylor and M. P. Pasternak (Tel-Aviv Univ., Israel ) 1991

18 p Presented at the Stan Hanna Mossbauer Spectroscopy Workshop, Stanford, CA, 15 Mar. 1991
(Contract W-7405-eng-36)
(DE91-016018; LA-UR-91-2381; CONF-9103193-1) Avail: NTIS HC/MF A03

Diamond anvil cells provide a means to obtain near-hydrostatic pressures from the kilobar to the megabar regime. Moessbauer spectroscopy (MS) nicely complements the optical and X-ray measurements usually made. After a brief summary of the techniques applicable to MS, we present several examples of high pressure MS including hysteresis in the alpha-epsilon transition in Fe, metallization in molecular crystals, and the insulator-metal Mott transition in NiI2 and CoI2. DOE

**N91-32962#** Sandia National Labs., Albuquerque, NM.
**IRRADIATION EFFECTS IN HIGH TEMPERATURE SUPERCONDUCTORS**
J. C. Barbour, E. L. Venturini, D. S. Ginley, and J. F. Kwak 1991 30 p Presented at the 6th Conference on Radiation Effects in Insulators, Weimar (Germany), 24-28 Jun. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016118; SAND-91-0864C; CONF-910646-5) Avail: NTIS HC/MF A03

Irradiation effects on Tl- and Y-based high temperatures superconductors (HTS) are compared. Ion irradiation can enhance the critical current density (J(sub c)) at low fluences through the interaction of defects with the flux lattice, and at higher fluences ion irradiation can degrade the superconducting transition temperature (Tc) and increase the normal state resistivity (rho). Low-fluence irradiation of Tl2Ca2Ba2Cu3O10 (Tl-2223) single crystals was shown to increase J(sub c) by an order of magnitude over J(sub c) for unirradiated crystals. Similarly, irradiated YBa2Cu3O(7-delta) (YBCO) crystals have increased by factors of 2 to 100; however the effects of irradiation on thin-film HTS from these two materials depends greatly on their crystalline quality. Ion irradiation of millimeter grain-size Tl-2223 films was shown to increase J(sub c) while similar irradiation of approximately 10 micron grain-size Tl-2223 films had little effect on J(sub c). For ions with energies less than (approximately)MeV/amu, the dominant mechanism causing irradiation-induced degradation of (Tc) is collisional damage. Both Tl-based and YBCO superconductors behave similarly in that (Tc) decreases linearly with the level of damage; yet, the rate of decrease in (Tc) for Tl-based superconductors (5000 K/dpa) was approximately twice that for irradiated YBCO. An examination of the temperature behavior and rate of damage recovery of (rho) yielded an activation energy of 0.36 eV for annealing defects. DOE

**N91-32963#** Ames Lab., IA.
**SINGLE VORTEX MOTION AND ELEMENTARY PINNING FORCE IN SNIS JOSEPHSON JUNCTIONS Ph.D. Thesis**
Qiang Li 18 Jul. 1991 132 p
(Contract W-7405-eng-82)
(DE91-016160; IS-T-1565) Avail: NTIS HC/MF A07

A new family of superconductor -- normal metal -- insulator -- superconductor (SNIS) Josephson junctions has been developed to study the motion of a single Abrikosov vortex under the influence of a Lorentz force from an applied transport current. The location of the vortex within the junction is determined by the diffraction pattern. Methods have been developed to nucleate a single vortex by applying a transport current in one strip of the junction and systematically to push the vortex to nearly any desired location within the junction by applying currents in either of the cross-strip legs of the junction. The vortex in thin film Pb was found to move stepwise from one pinning center to another. The average distance separating pinning centers in thin film Pb is about 1.0 micron. The elementary pinning force f(sub p) for a vortex in a pure Pb film was measured to be on the order of 10(exp -13) N at reduced temperature t = T/(Tc) = 0.9, which is about one order of magnitude smaller than that for a Pb-Bi film at this reduced temperature. The temperature dependence of F(sub p) was found to be f(sub p) approximately 1 minus T/(Tc) above 6.5 K and F(sub p) approximately 1 minus T/(Tc) (exp 2/3) below 6.5 K. The feasibility of using the motion of a single vortex to store information and perform logic has been investigated. Since the Josephson voltage is in the range of tens of millivolts, the read and write operations can be done with rather simple electronics. DOE

**N91-32964#** Ames Lab., IA.
**EXPERIMENTAL STUDIES OF LONG-RANGE ATOMIC H MOTION AND DESORPTION IN HYDROGENATED AMORPHOUS SILICON AND GERMANIUM Ph.D. Thesis**
Xiao-Lin Wu 11 Jul. 1991 136 p
(Contract W-7405-eng-82)
(DE91-016161; IS-T-1559) Avail: NTIS HC/MF A07

Long-range H motion and desorption in low hydrogen concentration undoped hydrogenated amorphous silicon (a-Si:H) and germanium (a-Ge:H) was studied by deuterium secondary ion mass spectrometry (SIMS) depth profiles and IR absorption of a-Si:H/a-Si:(H,D)/a-Si:H and a-Ge:H/a-Ge:(H,D)/a-Ge:H. SIMS monitors deuterium motion (assumed similar to that of H), while IR yields information on hydrogen content and bonding. The diffusion constant was found to be dispersive with time, and depended on H content C(sub H), diffusion length L, and microvoid content, at temperatures T less than or equal to 400 C for a-Si:H and T less than or equal to 310 C for a-Ge:H. In a-Ge:H, (alpha) is essentially temperature and composition independent, but increases with microvoid content. The activation energy E(sub a) ranges from 0.7 to 1.2 eV among the various films. The diffusion results for both a-Si:H and a-Ge:H are discussed in relation to the microstructure of the films. The nature of the microvoid-induced deep H-trapping sites is also discussed. Finally, a possible relation between the dispersive diffusion and a percolation model is presented. DOE

**N91-32965#** Argonne National Lab., IL.
**ION BEAMS IN HIGH-TEMPERATURE SUPERCONDUCTIVITY RESEARCH**
L. E. Rehn Jun. 1991 18 p Presented at the 10th International Conference on Ion Beam Analysis, Eindhoven (Netherlands), 1-5 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-016521; ANL/CP-72549; CONF-910715-2) Avail: NTIS HC/MF A03

As previous experience would suggest, ion beams have contributed to progress in high-(Tc) superconductivity research primarily in four ways. Ion beams have been employed for (1) analyzing composition and structural details, including phonon properties; (2) fabricating thin-film specimens; (3) modifying properties for specific applications; and (4) performing fundamental irradiation effects studies. Examples of these contributions are presented in this brief summary, and the success of different approaches is evaluated. The emphasis is on the use of intermediate (50 to 500 keV) and higher (0.5 to 10 MeV) energy ion beams; space limitations preclude covering the wide range of activities that have occurred in any detail. Substantial contributions from ion-beam techniques to the rapid progress that has occurred in high-(Tc) research are clearly evident. DOE

**N91-32966#** Argonne National Lab., IL.
**CRITICAL CURRENTS IN MELT-TEXTURED YBa2Cu3O(x)**
Donglu Shi, J. G. Chen, S. Salem-Sugui, Jr., and K. C. Goretta Jun. 1991 3 p Presented at the International Conference on Materials and Mechanisms of Superconductivity, Kanazawa (Japan), 22-26 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-016523; ANL/CP-72561; CONF-910736-9) Avail: NTIS HC/MF A01

YBa2Cu3O(x) bars and wires textured by partial-melt growth and zone-melting methods have been characterized. Specimens exhibited critical current densities (J(sub c)) greater than 10(exp 4) A/cm(exp 2) at 77 K in a 2 T field. The high J(sub c) values were related to the presence of low-angle grain boundaries and high concentrations of crystal defects. These defects were found to be effective flux-pinning centers. DOE

**N91-32967#** Argonne National Lab., IL.
**SCALING BEHAVIOR OF THE FLUCTUATIONS IN MAGNETIZATION AND CONDUCTIVITY OF UNTWINNED YBa2Cu3O(7-DELTA)**
U. Welp, W. K. Kwok, R. A. Klemm, J. Downey, G. W. Crabtree, S. Fleshler, and V. M. Vinokur (Academy of Sciences, USSR, Moscow ) Jun. 1991 3 p Presented at the International Conference on Materials and Mechanisms of Superconductivity, Kanazawa (Japan), 22-26 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-016524; ANL/CP-73645; CONF-910736-10) Avail: NTIS HC/MF A01

We present measurements of the magnetization and conductivity of a untwinned YBa2Cu3O(7 - delta) crystal near the superconducting transition. Both quantities display the scaling properties predicted on the basis of Ginzburg-Landau theory. The set of T(sub c)(H) which optimizes the scaling is the same for the magnetization and conductivity data and agrees well with earlier determinations. DOE

**N91-32968#** Argonne National Lab., IL.
**FLUX PINNING BY PLANAR DEFECTS IN SINGLE CRYSTAL YBa2Cu3O(7-DELTA)**
W. K. Kwok, U. Welp, J. Downey, G. W. Crabtree, S. Fleshler, and V. M. Vinokur (Academy of Sciences, USSR, Moscow ) Jun. 1991 3 p Presented at the International Conference on Materials and Mechanisms of Superconductivity, Kanazawa (Japan), 22-26 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-016525; ANL/CP-72998; CONF-910736-11) Avail: NTIS HC/MF A01

We report on a novel crossed magnetic field technique to study the critical angle of pinning by twin boundaries and intrinsic pinning by the layered structure in single crystal YBa2Cu3O(7-delta). We find a critical angle for intrinsic pinning very close to T(sub c) which is 10 times smaller than the critical angle for twin boundary pinning. In addition, we present the phase diagram for the onset of twin boundary and intrinsic pinning near T(sub c). DOE

**N91-32969#** Argonne National Lab., IL.
**MAGNETIC RELAXATION OF THE ORGANIC SUPERCONDUCTOR KAPPA-(BEDT-TTF)2Cu(N(CN)2)Br**
A. Umezawa, S. K. Malik, L. K. Montgomery (Indiana Univ., Bloomington.), G. W. Crabtree, and H. H. Wang Jun. 1991 3 p Presented at the International Conference on Materials and Mechanisms of Superconductivity, Kanazawa (Japan), 22-26 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-016528; ANL/CP-72996; CONF-910736-13) Avail: NTIS HC/MF A01

Magnetic relaxation was measured on a kappa-(ET)2Cu(N(CN)2)Br(ET = BEDT-TTF) single crystal for H/b (perpendicular to the conducting layers) at 6 K. The relaxation rate, dM/dlnt was found to have a maximum at 30 G. This maximum in the relaxation rate is thought to be the field of full penetration, H*, and agrees with the peak observed in the magnetization measurements for H//b at 6 K. The field dependence of the relaxation rate can be described by a thermally activated flux creep model where U sub 0 approx. 8.3 meV. DOE

**N91-32970#** Lawrence Livermore National Lab., CA.
**ANALOGOUS BEHAVIOR IN THE QUANTUM HALL EFFECT, ANYON SUPERCONDUCTIVITY, AND THE STANDARD MODEL**
R. B. Laughlin (Stanford Univ., CA.) and S. B. Libby Jul. 1991 18 p Presented at the Beyond the Standard Model 2: A Critical Review of the Standard Model and the Prospects for Discovering New Physics, Norman, OK, 1-3 Nov. 1990
(Contract W-7405-eng-48)
(DE91-016609; UCRL-JC-107770; CONF-901145-1) Avail: NTIS HC/MF A03

Similarities between physical behavior known to occur, or suspected of occurring, in simple condensed matter systems and behavior postulated by the standard model are identified and discussed. Particular emphasis is given to quantum number fractionalization, spontaneous occurrence of gauge forces, spontaneous violation of P and T, and anomaly cancellation. DOE

**N91-32971#** Oak Ridge National Lab., TN.
**EVIDENCE FOR CATION DISORDER IN IN-SITU GROWN YBaCuO SUPERCONDUCTING FILMS**
V. C. Matijasevic, R. H. Hammond, P. Rosenthal, A. F. Marshall, M. R. Beasley, K. Shinohara (Stanford Univ., CA.), and R. Feenstra 1991 5 p Presented at the International Conference on Advanced Materials (ICAM 91), Strasbourg (France), 27-31 May 1991 Prepared in cooperation with Nissan Motor Co. Ltd., Tokyo, Japan
(Contract DE-AC05-84OR-21400)
(DE91-016760; CONF-910580-4) Avail: NTIS HC/MF A01

Some of the still unanswered materials questions regarding in-situ films of cuprate superconductors are reviewed. As a case study are present YBa2Cu3O(y) thin films grown by evaporation in low oxygen pressure. Several anomalous results are found. For O2 pressure less than or equal to 10 mTorr, films with average composition substantially off the 1:2:3 stoichiometry have more bulk-like properties, including higher (Tc)'s compared to films made on-stoichiometry. Films made at lower oxygen pressure also have c-axis lattice constant expanded compared to the films made at higher pressure (greater than 100 mTorr). The films show evidence that they are hole-doped compared to the ideal material. Altogether, the results strongly suggest that metal-atom point-like defects are quenched into the films. A model based on the presence of Ba-for-Y substitution is discussed and found to be consistent with the experimental results. We suggest that these defects might be important for superconducting properties of in-situ films in general. DOE

**N91-32972#** Brookhaven National Lab., Upton, NY.
**MAGNETICALLY MEASURED IRREVERSIBILITY TEMPERATURES IN SUPERCONDUCTING OXIDES AND ALLOYS**
M. Suenaga, D. O. Welch, and R. Budhani 1991 8 p Presented at the 6th International Workshop on Critical Currents in Superconductors, Cambridge, England, 7-12 Jul. 1991
(Contract DE-AC02-76CH-00016)
(DE91-016895; BNL-46408; CONF-910710-2) Avail: NTIS HC/MF A02

Irreversibility temperatures T sub r (H) were magnetically measured for the aligned powders of superconducting oxides, La(1.85)Sr(0.15)CuO4, YBa2Cu3O7, Bi2Sr2CaCu2O8, and Bi2-Sr2Ca2Cu3O10, and for the metallic superconductors, Nb, Nb-Ti, Nb3Sn and PbMo6S8. The results are briefly discussed in terms of the thermally activated flux creep and lattice or the glass melting models for the irreversibility temperatures. Also, the measurement procedures for T sub r (H) using a SQUID magnetometer are described in detail, since the measuring methods and the criteria which are used for T sub r (H) are important in the determination and interpretation of the temperatures. DOE

**N91-32973#** Lawrence Livermore National Lab., CA.
**FERMI SURFACE MEASUREMENTS IN YBa2Cu3O(7-x) AND La(1.874)Sr(126)CuO4**
R. H. Howell, P. A. Sterne, F. Solal, M. J. Fluss, H. Haghighi, J. H. Kaiser, S. L. Rayner, R. N. West, J. Z Liu, and R. Shelton 25 Jun. 1991 3 p Presented at the International Conference on Materials and Mechanisms of Superconductivity, Kanazawa, Japan, 22-26 Jul. 1991
(Contract W-7405-eng-48)
(DE91-017094; UCRL-JC-107009; CONF-910736-15) Avail: NTIS HC/MF A01

We report new, ultra high precision measurements of the electron-positron momentum spectra of YBa2Cu3O(7-x) and La(1.874)Sr(126)CuO4. The YBCO experiments were performed on twin free, single crystals and show discontinuities with the symmetry of the Fermi surface of the CuO chain bands. Conduction

band and underlying features in LSCO share the same symmetry and can only be separated with the aid of LDA calculations.
DOE

**N91-32974#** Argonne National Lab., IL.
**X RAY DICHROISM AND FARADAY EFFECT STUDIES IN ORDERED AND DISORDERED Fe3Pt**
E. E. Alp, M. Ramanathan, S. Salem-Sugui, Jr., F. Oliver, V. Stojanoff, and D. P. Siddons (Brookhaven National Lab., Upton, NY.) Jul. 1991 10 p Presented at the 4th International Conference on Synchrotron Radiation Instrumentation, Manchester England, 15-19 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-017305; ANL/CP-72661; CONF-910730-5) Avail: NTIS HC/MF A02

The magnetic properties of Fe3Pt compound depend on the degree of disorder present in the system. We have compared a cold rolled, disordered sample with a heat treated, ordered sample using circularly polarized synchrotron radiation at the FeK (7112 eV) and at the PtL3 (11564 eV) absorption edge, as well as by Mossbauer Spectroscopy, and x ray diffraction. Fe-K edge dichroism is compared to the measurements of Faraday rotation using linearly polarized radiation. We found that the magnetic dichroism at the PtL3 edge is reduced when the disordered Fe3Pt is heat treated and ordered. We also report that it is easier to measure Faraday rotation at the K-edges of transition metals than the magnetic dichroism. DOE

**N91-32975#** Argonne National Lab., IL.
**A SIMPLE SAGITTAL FOCUSING CRYSTAL WHICH UTILIZES A BIMETALLIC STRIP**
G. S. Knapp, M. Ramanathan, H. L. Nian, A. T. Macrander, and D. M. Mills Jul. 1991 13 p Presented at the 4th International Conference on Synchrotron Radiation Instrumentation, Manchester, England, 15-19 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-017324; ANL/CP-72870; CONF-910730-7) Avail: NTIS HC/MF A03

A sagittal focusing monochromator which utilizes a bimetallic strip as its active focusing member has been designed and has undergone preliminary testing. The crystal bender is very easy to use as only setting the temperature of the bimetallic strip is necessary to adjust the focus. The mechanism utilizes bending rods mounted on live centers which prevent twisting of the crystal. A finite element analysis has been done on a new ribbed crystal which, based on the analysis, should have very small aberrations.
DOE

**N91-32976#** Sandia National Labs., Albuquerque, NM.
**AN OVERVIEW OF THE ELECTRONIC PROPERTIES OF InAs(1-x)Sb(x) STRAINED-LAYER SUPERLATTICES (O LESS THAN OR EQUAL TO x LESS THAN OR EQUAL TO 1)**
S. R. Kurtz, R. M. Biefeld, L. R. Dawson, and B. L. Doyle 1991 10 p Presented at the International Symposium on Gallium Arsenide and Related Compounds, Seattle, WA, 23-26 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE91-017458; SAND-91-0914C; CONF-9109208-2) Avail: NTIS HC/MF A02

There have been few attempts to bandgap engineer In(AsSb) semiconductors although In(AsSb) alloys have the smallest bandgaps and effective masses among the III-V semiconductors. In(AsSb) may prove useful for high speed devices, and this system is an obvious starting point to extend the optical response of III-V semiconductors to longer wavelength for infrared detectors and lasers. In this paper we summarize studies of the electronic and optical properties of In(AsSb) strained layer superlattices (SLSs) for a wide range of compositions. Previously, long wavelength infrared response was observed at low As content in these SLSs, and we concluded that a type 2 (or staggered) band offset occurs in the In(AsSb) system. Prototype infrared detectors have been fabricated from these structures. DOE

**N91-32977#** Sandia National Labs., Albuquerque, NM.
**ION IMPLANTATION EFFECTS IN CRYSTALLINE QUARTZ**
G. W. Arnold 1991 17 p Presented at the 6th Conference on Radiation Effects in Insulators, Weimar (Germany), 24-28 Jun. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016192; SAND-91-0863C; CONF-910646-3) Avail: NTIS HC/MF A03

Cantilever beam measurements of the stress induced in crystalline quartz by implantation of 150 keV and/or 250 keV He have shown that the data scale with energy into collisional processes. The damage state induced by the Ar implants does not lend itself to efficient utilization of the electronic component of subsequent He implantation in producing further disorder. The damage depth has been measured (optically) for a number of ions (1 x 10(exp 16) 250 keV/sq cm) and has been found to vary from about 0.63R(sub p) for He to about 1.84R(sub p) for Xe. Rutherford Backscattering Spectroscopy (RBS) measurements of range for Ar to Au give values in fair agreement with the optical values. The ratio of the measured (optical) ranges to the predicted ranges, when plotted as a function of collisional energy deposition, indicates that extended damage (beyond ion range) occurs for deposition energies greater than approximately 1 x 10(exp 22) keV/cu cm. The damage persists even after 900 C anneals. The effects of ion-induced stress may be an important factor in the establishment of the extended damage state. DOE

**N91-32978#** Brookhaven National Lab., Upton, NY.
**SPECULAR AND DIFFUSE SCATTERING STUDIES OF MULTILAYER INTERFACES**
M. K. Sanya, S. K. Sinha, A. Gibaud, S. K. Satija, C. F. Majkrzak, and H. Homa (City Univ. of New York, Brooklyn.) 1991 4 p Presented at the 2nd International Conference on Surface X Ray and Neutron Scattering, Bad Honnef (Germany), 25-28 Jun. 1991
(Contract DE-AC02-76CH-00016)
(DE91-016893; BNL-46414; CONF-9106241-2) Avail: NTIS HC/MF A01

The results of specular and diffuse x ray scattering studies of multilayers are discussed. We show here that such studies can yield detailed statistical information about the interfacial roughness and morphology. Results on a GaAs/AlAs multilayers are presented and the data is analyzed within the Born approximation. DOE

**N91-32979#** Lawrence Livermore National Lab., CA.
**MECHANISMS OF DEFECT PRODUCTION AND ATOMIC MIXING IN HIGH ENERGY DISPLACEMENT CASCADES: A MOLECULAR DYNAMICS STUDY**
T. DiazdelaRubia and M. W. Guinan Jun. 1991 22 p Presented at the International Conference on Physics of Irradiation Effects in Metals, Siofok (Hungary), 20-24 May 1991
(Contract W-7405-eng-48)
(DE91-017082; UCRL-JC-107488; CONF-9105130-6) Avail: NTIS HC/MF A03

We have performed molecular dynamics computer simulation studies of displacement cascades in Cu at low temperature. For 25 keV recoils we observe the splitting of a cascade into subcascades and show that cascades in Cu may lead to the formation of vacancy and interstitial dislocation loops. We discuss a new mechanism of defect production based on the observation of interstitial prismatic dislocation loop punching from cascades at 10 K. We also show that below the subcascade threshold, atomic mixing in the cascade is recoil-energy dependent and obtain a mixing efficiency that scales as the square root of the primary recoil energy. DOE

**N91-32980#** Lawrence Livermore National Lab., CA.
**MICROSTRUCTURAL CHANGE AND ITS INFLUENCE ON STRESS-STRAIN BEHAVIOR OF TWO SUPERPLASTIC MATERIALS**
D. R. Lesuer, C. K. Syn, K. L. Cadwell, and S. C. Mance May 1991 8 p Presented at the International Conference on Superplasticity in Advanced Materials (ICSAM-91), Osaka, Japan, 3-6 Jun. 1991

(Contract W-7405-eng-48)
(DE91-017431; UCRL-JC-105422; CONF-9106185-2) Avail: NTIS HC/MF A02

The influence of microstructural evolution on tensile stress-strain behavior during superplastic flow has been studied for a quasi-single phase metal (Coronze 638) and a microduplex metal (ultrahigh-carbon steel -- UHCS). The grain growth in UHCS during superplastic deformation has also been studied as a function of strain and strain rate. The stress-strain response was calculated by combining an empirical grain growth equation with simple constitutive laws for regions 2 and 3. Results show that hardening in these materials can be explained on the basis of grain growth. DOE

**N91-32981#** Argonne National Lab., IL.
**APPLICATION OF A THERMAL SPIKE MODEL TO EXPERIMENTAL ION-INDUCED GRAIN GROWTH DATA**
D. E. Alexander and G. S. Was (Michigan Univ., Ann Arbor.) Jul. 1991 15 p Presented at the 7th International Conference on Surface Modification of Metals By Ion Beams (SMMIB-7), Washington, DC, 15-19 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-017320; ANL/CP-73384; CONF-910707-6) Avail: NTIS HC/MF A03

A model of ion-induced grain growth is developed incorporating the irradiation effect concept of thermal spikes. The results of the model predict that for normal grain growth the ion-induced mobility is linearly proportional to the quantity F(sub D)(exp 2)/(Delta)H(sub coh)(exp 3), where F(sub D) is the ion and recoil energy deposited in nuclear interactions and (triangle)H(sub coh) is the cohesive energy. This linearity is shown to be supported by the data from six of seven previous ion-induced grain growth experiments. The model analysis is combined with the experimental data to determine values of the proportionality constant, (beta)(sub 2GG), relating the cohesive energy to the activation energy for grain growth. The values are found to span a range, 0.02 less than or = (beta)(sub 2GG) less than or = 0.10, which is less than the value previously determined for the thermal spike treatment of ion beam mixing ((beta)(sub IM) equals 0.014), and therefore consistent with the idea that atom migration across grain boundaries is easier than migration within the lattice. The consistency of results from the analysis of an entirely different phenomenon, adds further credence to the thermal spike treatment of ion-induced grain growth. Finally, it is recommended that additional experiments be performed to further evaluate the model's validity. DOE

**N91-32982#** Argonne National Lab., IL.
**CRYOGENIC COOLING OF X RAY CRYSTALS USING POROUS MATRIX**
T. M. Kuzay 1991 16 p Presented at the 4th International Conference on Synchrotron Radiation Instrumentation, Manchester, England, 15-19 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-017322; ANL/CP-72980; CONF-910730-6) Avail: NTIS HC/MF A03

It is well established that Si and SiC have very desirable thermophysical properties at cryogenic temperatures. This feature makes cryo-cooled optics potentially a good candidate for the first optical crystal of the presently built third generation synchrotron machines with very high heat flux levels. Currently, there is a great deal of interest in such cryo-cooled crystals pursued both experimentally and analytically. The analytical studies involve cut micro or capillary channel crystals. As opposed to the machined channels, porous matrices provide significant advantages. They operate very quietly. Such matrices are known to affect superior heat transfer enhancement. Data available in open literature suggest that surface heat flux levels up to approximately 8 kW/sq cm are possible. For cryogens for which the boiling heat transfer heat flux is rather a low value in conventional geometries, the enhancement available with such matrices is a very significant characteristic. Cryogens are poor thermal conductors themselves. The fact that at the cryogenic temperatures the Si and/or SiC matrix itself becomes highly conductive, the matrix distributes the surface heat flux into the full volume effectively offsetting the poor conductivity of the coolant. In addition the tortuous path of the coolant through the matrix increases the dwell time for better heat transfer at the expense of increased pressure drop. In this study, thermal conductivity of such composite matrices and the effective heat transfer coefficient obtainable using them are investigated. A first optics crystal model of Si with Si and/or SiC porous matrix as its heat exchanger and subject to prototype synchrotron level heat flux is analyzed and limits of the cooling possible with liquid nitrogen in single phase and subcooled boiling heat transfer modes are delineated. DOE

**N91-32983#** EG and G Energy Measurements, Inc., Goleta, CA.
**OPTICAL DIAGNOSTICS OF MERCURIC IODIDE CRYSTAL GROWTH**
A. Burger, S. H. Morgan, E. Silberman (Fisk Univ., Nashville, TN.), and D. Nason 15 Jun. 1991 6 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract DE-AC08-88NV-10617)
(DE91-017396; EGG-10617-2086; CONF-9107115-33) Avail: NTIS HC/MF A02

Two optical methods were recently developed for in situ monitoring of the growth process of mercuric iodide crystals. The first method uses resonance fluorescence spectroscopy (RFS) for the determination of iodine vapor present in the growth ampule, which is an important parameter in determining the stoichiometry, and therefore the quality of the crystals. The second method, Reflectance Spectroscopy Thermometry (RST) measures the crystal face temperature with a percent accuracy of plus or minus 1.5 C. DOE

**N91-32984#** California Univ., Santa Barbara.
**BIFURCATIONS AND PATTERNS IN NON-LINEAR DISSIPATIVE SYSTEMS**
C. Ahlers and D. S. Cannell 1991 9 p
(Contract DE-FG03-87ER-13738)
(DE91-017402; DOE/ER-13738/T1) Avail: NTIS HC/MF A02

This report discusses Rayleigh-Benard convection with an imposed horizontal flow; Rayleigh-Benard convection in a gas under non-Boussinesq conditions; electro-convection in a nematic liquid crystal; Rayleigh-Benard convection in a nematic liquid crystal; and stochastic effects in the dynamics of Rayleigh-Benard convection. DOE

**N91-32985#** Lawrence Livermore National Lab., CA.
**SPECTROSCOPIC PROPERTIES OF Nd3+ DOPANT IONS IN PHOSPHATE LASER GLASS**
S. A. Payne, M. L. Elder, J. H. Campbell, G. D. Wilke, M. J. Weber, and Y. T. Hayden May 1991 9 p Presented at the 93rd Annual Meeting and Exposition of the American Ceramic Society (ACerS), Cincinnati, OH, 28 Apr. - 2 May 1991
(Contract W-7405-eng-48)
(DE91-017665; UCRL-JC-105473; CONF-910430-21) Avail: NTIS HC/MF A02

The spectroscopic properties of Nd(3+) dopants have been characterized for a variety of phosphate glass compositions. The 1.05 microm emission bandwidth may be minimized and the cross section maximized by increasing the P2O5 in the glass, and by reducing the alumina content. The emission bandwidth is strongly correlated with the extent of concentration quenching, in that it becomes more favorable for smaller bandwidth values. The development of a superior phosphate glass for laser fusion applications requires that the Nd spectroscopic properties be considered within the context of other issues that impact the cost and performance of the system. DOE

**N91-32986#** Argonne National Lab., IL.
**MAGNETIC RELAXATION IN A SINGLE CRYSTAL OF YBa2Cu3O(x)**
Donglu Shi and S. Salem-Sugui, Jr. 1991 3 p Presented at the 1991 Chinese Academy of Science Physical Workshop for Young Scientists, Beijing, Peoples Republic of China, 19-24 Aug.

1991
(Contract W-31-109-eng-38)
(DE91-017963; ANL/CP-73887; CONF-9108143-1) Avail: NTIS HC/MF A01

We report magnetic relaxation in a single crystal of YBa2Cu3O(x) at a wide range of temperatures and applied fields. We interpret the magnetic relaxation by combining Bean's critical state-model and the Anderson-Kim flux creep theory. The effect of temperature and field dependence of flux creep rate and the relationship between the flux-creep activation pinning energy and the decay of the persistent current are discussed. DOE

**N91-32987#** Argonne National Lab., IL.
**CRITICAL CURRENTS IN SPUTTERED YBCO FILMS**
R. M. Schalk, H. W. Weber, Z. H. Barber, C. E. Davies, J. E. Evetts, R. E. Somekh (Cambridge Univ., England ), and D. Kim Jul. 1991 5 p Presented at the 6th International Workshop on Critical Currents in Superconductors, Cambridge, England, 7-12 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-017976; ANL/CP-73886; CONF-910710-3) Avail: NTIS HC/MF A01

The angular dependence of J(sub c) was investigated for c-axis oriented sputtered YBCO films. The observed features can be described neither by a 2D- nor by a 3D-anisotropic Ginzburg-Landau theory. An intrinsic pinning mechanism, effective only within a critical angle, theta sub c, between the applied magnetic field and the copper oxide planes, has to be considered in order to describe the sharp and narrow peaks of J(sub c) at high fields and high temperatures. Neutron irradiation results also seem to be in favor of an intrinsic pinning model. DOE

**N91-32988#** Argonne National Lab., IL.
**FLUX DYNAMICS IN HIGH-Tc SUPERCONDUCTORS**
Valerie V. Vinokur, Gianni Blatter (Eidgenoessische Technische Hochschule, Zurich, Switzerland ), and Michail V. Feigelman Jul. 1991 7 p Presented at the International Conference on Materials and Mechanisms of Superconductivity, Kanazawa, Japan, 22-26 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-017977; ANL/CP-73057; CONF-910736-16) Avail: NTIS HC/MF A02

The theory of collective creep describing flux motion in a vortex glass state, and the theory of pinning of a vortex liquid by weak disorder are discussed. The exact solution for flux creep in a single-vortex pinning regime, and the theory of quantum collective creep are presented. DOE

**N91-32989#** Argonne National Lab., IL.
**ANISOTROPY IN THE a-b PLANE OF NORMAL AND SUPERCONDUCTING YBa2Cu3O(x)**
G. W. Crabtree, W. K. Kwok, U. Welp, A. Umezawa, K. G. Vandervoort, S. Fleshler, J. Downey, Y. Fang, and J. Z. Liu (California Univ., Davis.) Jul. 1991 24 p Presented at the International Workshop on Electronic Properties and Mechanics in High-T(c) Superconductors, Tsukuba, Japan, 29-31 Jul. 1991
(Contract W-31-109-eng-38)
(DE91-017997; ANL/CP-73929; CONF-9107143-2) Avail: NTIS HC/MF A03

The anisotropy of the normal state resistivity, magnetic susceptibility, and the superconducting upper and lower critical fields in the ab plane of untwinned crystals of YBa2Cu3O(x) is reviewed. While anisotropy is found in the normal state, none is found for the superconducting state. This behavior strongly supports the conclusion that the chains do not participate in the superconductivity, but raises questions about the effect of proximity. DOE

# 77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

**N91-32990#** Westinghouse Hanford Co., Richland, WA.
**THE ESSENTIAL LINEARITY OF THERMAL RADIATION NET TRANSPORT**
J. J. Barker Jun. 1991 6 p Presented at the American Chemical Society Symposium on Emerging Technologies for Hazardous Waste Management, Atlanta, GA, 1-3 Oct. 1991
(Contract DE-AC06-87RL-10930)
(DE91-016734; WHC-SA-1132; CONF-911071-2) Avail: NTIS HC/MF A02

Thermal radiation net transport is proportional to the difference in the fourth powers of the absolute temperatures of the radiator and the receiver. During a study of heat transfer mechanisms in the underground storage tanks for the radioactive wastes at the Hanford Site in Washington, it was discovered that the fourth power difference is approximated by a linear function of the temperature difference between the radiator and the receiver, with astounding fidelity. This linearity makes satisfying boundary conditions for analytical and numerical calculations much simpler and simplifies comparisons with other modes of heat transfer. The paper derives the relationship and illustrates its use by demonstrating that radiation transports more heat through the air space in the tank than does natural convection. DOE

**N91-32991#** Oak Ridge National Lab., TN.
**ADVANTAGES OF ENTHALPY-TEMPERATURE DIAGRAMS FOR NONAZEOTROPIC REFRIGERANT MIXTURES**
E. Granryd (Royal Inst. of Tech., Stockholm, Sweden ), J. C. Conklin, and J. R. Sand 15 Aug. 1991 11 p Presented at the International Congress on Refrigeration: New Challenges in Refrigeration, Montreal (Canada), 10-17 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE91-016774; CONF-910803-1) Avail: NTIS HC/MF A03

The enthalpy-temperature diagram for nonazeotropic refrigerant mixtures has illustrative and useful features, combining the advantages of the entropy-temperature diagram and the enthalpy-pressure diagram commonly used in the refrigeration and heat pump industry. Plotting temperature versus enthalpy has advantages similar to those of plotting pressure versus enthalpy, and has the additional advantages of depicting the temperature profiles for both sides of the heat exchange equipment during the cycle. This additional advantage is particularly useful for analyzing the vapor compression refrigeration cycle using nonazeotropic refrigerant mixtures, where nonisothermal phase-change processes occur. Problems such as heat exchanger pinch-points and wet compression are easily detected. The possible cycle enhancement due to a liquid-to-suction heat exchanger is readily apparent. This paper presents and discusses examples of enthalpy-temperature diagrams. DOE

**N91-32992#** California Univ., Berkeley. Lawrence Berkeley Lab.
**THERMODYNAMICS OF COMBUSTION IN AN ENCLOSURE**
A. K. Oppenheim and J. A. Maxson Jun. 1991 21 p Presented at the 13th International Colloquium on Dynamics of Explosives and Reactive Systems, Nagoya (Japan), 28 Jul. - 31 Aug. 1991
(Contract DE-AC03-76SF-00098)
(DE91-016430; LBL-30890; CONF-9107160-1) Avail: NTIS HC/MF A03

A systematically construed thermodynamic analysis of combustion in an enclosure is presented. The system is treated as one consisting of two components: the reactants and the products, both under the same, time varying, pressure. Whereas the former undergoes a prescribed change of state, usually isentropic or polytropic, the latter is, as a rule, at a thermodynamic equilibrium. In the course of the process, the two delineate distinct

loci of states on a Le Chatelier diagram, trajectories on the plane of specific internal energy and the product of pressure and specific volume as its coordinates. The analysis is concerned primarily with the evaluation of the consequences of three conditions of constraint: the balance of mass, balance of volume, and balance of energy, each forming a component of a vector equation. The application of this method of approach is illustrated by a number of examples. Its major advantage is the precision one gains in evaluating the relationship between pressure and mass, as well as volume, of the two components of the system. DOE

# 80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

# 81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**N91-32993#** Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
**DEVELOPMENT OF A HANDBOOK FOR CONFIGURATION MANAGERS WITH APPLICATIONS FOR THE PROGRAM/SYSTEM IN FULL-SCALE DEVELOPMENT M.S. Thesis**
James E. Corbin Sep. 1990 351 p
(AD-A229617; AFIT/GSM/LSY/90S-5) Avail: NTIS HC/MF A16 CSCL 05/1

This study resulted in the development of a Configuration Manager's Handbook that is intended to assist Air Force program offices and configuration management personnel apply the principles of configuration management to a product under development. The handbook can be used as a training document for in-coming personnel to a program office. It begins by briefly discussing the system acquisition life cycle as the domain in which a program is developed and the role of systems engineering in the development and design of the product. Configuration management is then introduced as a technical management control system that complements the technical actions undertaken during the systems engineering process. The handbook then proceeds to introduce, and in subsequent sections describe, the four processes that comprise configuration management: configuration identification, configuration audits, change management, and configuration status accounting. Finally, the uses of these processes for the program in full-scale development are discussed. This includes providing suggestions for the contents of Operating instructions that should be produced by configuration managers to describe the specific applications of configuration management principles within the program office, and of Statement of Work tasks that should be required of the contractor. GRA

**N91-32994#** Krupp (Fried.) G.m.b.H., Essen (Germany, F.R.).
**KRUPP TECHNICAL REPORTS, NUMBER 2, DECEMBER 1990 (ENGLISH VERSION)**
Dec. 1990 63 p
(ISSN-0930-9276; ETN-91-90011) Avail: NTIS HC/MF A04

Six papers are presented. The topics covered include: (1) Europe 1993, the single European market and Research and Development (R&D) policy at Krupp; (2) the role of Krupp Forschungsintitut in international research and development cooperation; (3) R&D projects which Krupp Altas Elektronic are undertaking with partners from other European countries; (4) Europe 1993, challenge opportunity for distribution logistics; (5) the manufacture of containers from an oriented biopolymer; and (6) the development of polymer alloys for electrical engineering applications. For individual titles, see N91-32995 through N91-33000.

**N91-32995#** Essen Univ. (Germany, F.R.). Dept. of International Economic Relations.
**EUROPE 1993: THE SINGLE EUROPEAN MARKET AND R AND D POLICY AT KRUPP**
Karlhans Sauernheimer (Krupp, Fried. G.m.b.H., Essen, Germany, F.R. ) and Hjalmar Kuntz *In* Krupp (Fried.) G.m.b.H., Krupp Technical Reports, Number 2, December 1990 (English Version) Dec. 1990 p 67-82 (For primary document see N91-32994 24-81)
Avail: NTIS HC/MF A04

An overview of the mainsteps leading to the creation of the single European market is given, the broader perspectives of political and economic union are examined and the implications of these developments for industrial planning in general and for Krupp in particular are highlighted. The interweaving of European Community (EC) oriented aspects of technology into research and development planning, the evolution and current status of research and development cooperation between Krupp and the EC and the opportunities that exist for strengthening cooperation further on the basis of current EC funding programs are described. ESA

**N91-32996#** Krupp (Fried.) G.m.b.H., Essen (Germany, F.R.).
**THE ROLE OF KRUPP FORSCHUNGSINSTITUT IN INTERNATIONAL R AND D COOPERATION**
Bernd Schoenwald and Stephen Harris *In its* Krupp Technical Reports, Number 2, December 1990 (English Version) Dec. 1990 p 83-90 (For primary document see N91-32994 24-81)
Avail: NTIS HC/MF A04

International competition begins in the industrial development laboratory. With the aim of making better use of funds expended on research and development the European Community has set up numerous programs designed to encourage a joint approach by industrial partners at the precompetitive stage, particularly in the form of linkups between product developers and users, to ensure optimum application of resources. As a participant in numerous projects, Krupp Forschunginstitut is a highly regarded partner in this form of European cooperation. ESA

**N91-32997#** Krupp Atlas-Elektronik, Bremen (Germany, F.R.).
**KNOW-HOW FOR EUROPE**
Hans-Peter Leppin and Thies Wittig *In* Krupp (Fried.) G.m.b.H., Krupp Technical Reports, Number 2, December 1990 (English Version) Dec. 1990 p 91-102 (For primary document see N91-32994 24-81)
Avail: NTIS HC/MF A04

Lively project activity is evolving under the financial and organizational umbrella of the European Community. Now, in the second framework program of ESPRIT, more than 500 companies and scientific establishments have joined together in targeted collaboration in more than 200 projects. The focal area is information technology, a key indicator of social and economic development. The total number of EUREKA projects, which unlike those in ESPRIT are not centrally controlled and financed from Brussels, has risen to more than 400. The research and development projects which Krupp Atlas Elektronic are undertaking with partners from other European countries are discussed. ESA

**N91-32998#** Krupp Widia G.m.b.H., Essen (Germany, F.R.).
**EUROPE 1993: CHALLENGE AND OPPORTUNITY FOR DISTRIBUTION LOGISTICS**
Hans Pegels *In* Krupp (Fried.) G.m.b.H., Krupp Technical Reports, Number 2, December 1990 (English Version) Dec. 1990 p 103-112 (For primary document see N91-32994 24-81)
Avail: NTIS HC/MF A04

The single European market will be the world's second biggest market. If the opportunities this creates are to be exploited successfully over the long term, the key decisions have to be taken now. Decisive importance will attach to a reorientation of

strategies for market approach, product mix, production structures, and above all distribution logistics. These aforementioned subjects are discussed. ESA

**N91-32999#** Krupp Corpoplast Maschinenbau G.m.b.H., Hamburg (Germany, F.R.).
**MANUFACTURE OF CONTAINERS FROM AN ORIENTED BIOPOLYMER**
Wolfgang Reymann, Michael Koch, and Peter Albrecht *In* Krupp (Fried.) G.m.b.H., Krupp Technical Reports, Number 2, December 1990 (English Version) Dec. 1990 p 113-118 (For primary document see N91-32994 24-81)
Avail: NTIS HC/MF A04

Krupp Corpoplast is collaborating with ICI in a BRITE EURAM research concerned with the development of a polymer produced from biological raw materials and a matching blow molding technology. The key technological aspects underlying cooperation between the two partners are outlined. ESA

**N91-33000#** Werner und Pfleiderer G.m.b.H. (Germany, F.R.). Process Engineering, Plastics and Chemical Processing Machinery Div.
**DEVELOPMENT OF POLYMER ALLOYS FOR ELECTRICAL ENGINEERING APPLICATIONS**
Heinz Herrmann *In* Krupp (Fried.) G.m.b.H., Krupp Technical Reports, Number 2, December 1990 (English Version) Dec. 1990 p 119-125 (For primary document see N91-32994 24-81)
Avail: NTIS HC/MF A04

The development of polymer blends and alloys represents a main area of international polymer research. Under a BRITE research project laboratoires de Marcoussis, the Institute of Macromolecular Chemistry of Liege University and Werner and Pfleiderer GmbH are cooperating in research into new polymer alloys for electrical engineering applications. The BRITE research project is discussed. ESA

**N91-33001#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany, F.R.). Forschungsbereich Energetik.
**FINITENESS: ON CONSTRAINTS OF APPLIED RESEARCH**
Carl-Jochen Winter Feb. 1991 28 p In GERMAN; ENGLISH summary Presented at the DLR Colloquium 15 Jahre Energetik, 15 Jahre Werkstoffe und Bauweisen, 23-24 Jan. 1991 Report will also be announced as translation ESA-TTT-1270
(DLR-Mitt-91-06; ISSN-0939-298X; ETN-91-90034; ESA-TT-1270)
Avail: NTIS HC/MF A03; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 9.50 DM

Finiteness in nature is in conflict with the quasi-infiniteness of anthropogenic technological developments. If we continue to act as if only we and our outdated maxims count, a resolution is probably not possible. The only way for a resolution to become possible is if we become aware of a need to: do more with less; regard ourselves as parts of a whole; see progress in conserving; understand technology as a system's component; respect the borders set by the finiteness of nature; supplement and eventually to replace open systems with closed loops; redefine what is economically viable as what is relatively economically viable in a given time and place; and put the quality of our actions before their quantity. Responsible research will have to take systems' limitations into account. ESA

**N91-33002#** Sandia National Labs., Albuquerque, NM.
**TEACHING ENGINEERS TO BE TECHNICAL LEADERS**
T. Cannon 1991 6 p Presented at the IEEE USA's Biennial Careers Conference, Denver, CO, 10 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE91-016117; SAND-91-1719C; CONF-9110171-2) Avail: NTIS HC/MF A02

Engineers invest several years becoming skilled in the many disciplines necessary to effectively carry out analysis, design and development. This typically includes math, physics, computer science, and special study in their core area of expertise. However, once promoted into management, engineers use less and less of these hard-earned technical skills and find themselves operating in nontechnical arenas in which they have little or no formal training. (The formal training that they do get is often through company-sponsored courses, lacking both the rigor and cohesiveness that they have grown accustomed to in their engineering curriculum.) Often, what they are exposed to are continually varying management doctrines that resemble the flavor of the month, each laying claim to the true secrets of motivation, productivity, and organizational competitiveness. Under such circumstances, it is difficult for the neophyte manager to sort out fact from fancy, and help from hype. It therefore would be helpful to put such theories in perspective and present them in a form most easily digested by technical managers, i.e., from an analytical point of view. This paper attempts to do just that. There are many factors that influence a manager's career progression. One of the most rational factors is how the manager's actions affect the productivity of his or her group. This paper focuses on principles and techniques that a manager can, and should, employ to improve group productivity and enhance his or her opportunities for further advancement. DOE

**N91-32372#** Spur Electron Ltd., Havant (England).
**EEC COMPONENT PROCUREMENT: A LOOK AHEAD**
M. Snowdon *In* ESA, ESA Electronic Components Conference Mar. 1991 p 515-517 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32373#** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Components Div.
**ESA's COMPONENT PROGRAMME PLAN**
U. Ernsberger *In its* ESA Electronic Components Conference Mar. 1991 p 519-522 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32374*#** National Aeronautics and Space Administration, Washington, DC.
**NASA's CHALLENGE FOR TOMORROW**
Daniel L. Barney *In* ESA, ESA Electronic Components Conference Mar. 1991 p 523-529 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders CSCL 09C

**N91-32375#** TRW Components International, Inc., Torrance, CA.
**PARTS MANAGEMENT FOR THE 1990's**
S. Jennings and M. Scott *In* ESA, ESA Electronic Components Conference Mar. 1991 p 531-534 (For primary document see N91-32291 24-33)
Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32376#** IGG Component Technology Ltd., Portsmouth (England).
**UPSCREENING OF COMPONENTS FOR SPACE APPLICATIONS**
R. Fidler *In* ESA, ESA Electronic Components Conference Mar. 1991 p 537-544 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32379#** Tecnologica S.A., La Laguna (Spain).
**CPFS: THE TOTAL INFORMATION SYSTEM TOOL FOR EEE-PARTS PROCUREMENT**
F. Garrido *In* ESA, ESA Electronic Components Conference Mar. 1991 p 555-560 (For primary document see N91-32291

24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

# 82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

**N91-33003** Southern Methodist Univ., Dallas, TX.
**THE USE OF SOFTWARE METRICS TO EVALUATE INFORMATION SYSTEMS Ph.D. Thesis**
Douglas Frank Benn 1990 290 p
Avail: Univ. Microfilms Order No. DA9102178

This system provides an engineering solution to the complex problem of system assessment of existing large information systems. Two models were developed that use various established software metrics, including size and McCabe's Metric of complexity for a system, producing the resource needs and costs normally incurred in the various phases of the system lifecycle and a discounted cash flow analysis. These models are implemented on a PC. Model LOC provides analysis of a system without access to the source code. When the source code can be read by a parser, Model CLOC utilizes various software metrics to improve the accuracy of the assessment. The resulting nominal costs provide an acceptable assessment of a fair value for systems written in one or a mix of several 3rd and 4th Generation Languages, including COBOL, PL/1, CICS, and all 4GLs. Over 1200 simulated and actual large systems evaluations were completed using this methodology. Dissert. Abstr.

**N91-33004#** Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
**IDENTIFICATION OF ESSENTIAL SUCCESS FACTORS FOR AN ELECTRONIC MASTER PUBLICATION LIBRARY M.S. Thesis**
Michele M. Ohotnicky Sep. 1990 214 p
(AD-A229624; AFIT/GIR/LSM/90D-9) Avail: NTIS HC/MF A10 CSCL 12/6

For the purposes of this thesis, electronic libraries are defined as databases of information accessible via an electronic medium, such as a computer, with characteristics such as key word searching, ability to be updated, ability to be distributed as necessary, and ability to serve a variety of users. This research seeks to assess the success of previous and on-going electronic library projects and to make use of the knowledge their managers have gained through the development and implementation process to ensure similar projects planned for the Air Force are successful. The Air Force has proposed using CD-ROM based technology to create an electronic master publications library. Structured interviews with ten managers experienced in the development and implementation of similar projects were conducted. The interviewees identified the following as essential success factors in developing and implementing their projects: planning; identification of user needs; clear and specific goals/objectives; system performance; developer competence; management support; and hardware interface standards. Recommendations based on lessons learned include: avoiding multidisc drives due to problems experienced; updating CD-ROM discs annually with interim changes distributed via magnetic media using software to link with CD-ROM, using the expertise and equipment of contractors in CD-ROM production, and the importance of issues related to computer searching. GRA

**N91-33005*#** Research Inst. for Advanced Computer Science, Moffett Field, CA.
**COPING WITH DATA FROM SPACE STATION FREEDOM**
Marjory J. Johnson Jan. 1991 29 p Submitted for publication (Contract NCC2-387)
(NASA-CR-188885; NAS 1.26:188885; RIACS-TR-91-05) Avail: NTIS HC/MF A03 CSCL 05B

The volume of data from future NASA space missions will be phenomenal. Here, we examine the expected data flow from the Space Station Freedom and describe techniques that are being developed to transport and process that data. Networking in space, the Tracking and Data Relay Satellite System (TDRSS), recommendations of the Consultative Committee for Space Data systems (CCSDS), NASA institutional ground support, communications system architecture, and principal data types and formats are discussed. Author

**N91-33006#** United States-Japan Task Force on Scientific and Technical Information.
**JAPAN-US LIAISON GROUP ON JOINT DATABASES DEVELOPMENT**
16 Jul. 1991 20 p Third Meeting held in Tokyo, Japan, 16 Jul. 1991
(PB91-214056) Avail: NTIS HC/MF A03 CSCL 05B

The following subject areas are covered: summary of the Joint Database Liaison Group meeting; the scientific and technical database project at the Defence Technical Information Center (DTIC); data management for Global Change research policy statements; and Japanese and U.S. participants for liaison meeting of Joint Database Development. Author

**N91-33007#** Defense Logistics Agency, Alexandria, VA.
**DEFENSE LOGISTIC AGENCY (DLA) LONG-RANGE INFORMATION RESOURCES MANAGEMENT (IRM) PLAN, FY 1991 - FY 1997. VOLUME 1: AGENCY-WIDE PLAN IRM SUMMARY INFORMATION: AGENCY**
1991 139 p
(PB91-204529) Avail: NTIS HC/MF A07; also available in set of 4 reports as HC/MF E99 CSCL 05B

The results of executing the newly created DLA IRM Plan processes are presented. The scope of the DLA Long-range IRM plan FY 1991 to 1997 encompasses the management of information itself and its related resources, such as personnel, equipment, funds, and technology. Author

**N91-33008#** Defense Logistics Agency, Alexandria, VA.
**DEFENCE LOGISTICS AGENCY (DLA) LONG-RANGE INFORMATION RESOURCES MANAGEMENT (IRM) PLAN, FY 1991 - FY 1997. VOLUME 2: INDIVIDUAL ORGANIZATIONAL IRM PLANS: ORGANIZATIONS**
1991 266 p
(PB91-204537) Avail: NTIS HC/MF A12; also available in set of 4 reports as HC/MF E99 CSCL 05B

The DLA IRM plan for FY 1991 to 1997 was prepared to provide the beginnings of an IRM framework and strategic direction needed in the development of future requirements. The goal of the planning process is to ensure that DLA improves customer support and program management, increases productivity and quality, reduces inefficiencies, and uses limited resources more effectively. Author

**N91-33009#** Defense Logistics Agency, Alexandria, VA.
**DEFENSE LOGISTICS AGENCY (DLA) LONG-RANGE INFORMATION RESOURCES MANAGEMENT (IRM) PLAN, FY 1991 - FY 1997. VOLUME 3: INFORMATION SYSTEMS/PROJECTS/PROGRAMS/ACQUISITIONS: CATALOGUE**
1991 235 p
(PB91-204545) Avail: NTIS HC/MF A11; also available in set of 4 reports as HC/MF E99 CSCL 05B

The DLA IRM plan for FY 1991 to 1997 was prepared to provide the beginnings of an IRM framework and strategic direction needed in the development of future requirements. The goal of the planning process is to ensure that DLA improves customer support and program management, increases productivity and quality, reduces inefficiencies, and uses limited resources more

effectively. The necessary information systems, project plans, and acquisitions catalog is presented. Author

**N91-33010#** Defense Logistics Agency, Alexandria, VA.
**DEFENCE LOGISTICS AGENCY (DLA) LONG-RANGE INFORMATION RESOURCES MANAGEMENT (IRM) PLAN, FY 1991 - FY 1997. VOLUME 4: REFERENCE INFORMATION: REFERENCE**
1991 233 p
(PB91-204552) Avail: NTIS HC/MF A11; also available in set of 4 reports as HC/MF E99 CSCL 05B

Volume 4 of the IRM plan presents reference information and supplements volumes 1 to 3. Data included are definitions, regulations, defense management review decisions, source information, table of contents, IRM requirements' line item numbers index, and the index. Author

**N91-33011#** Strategic Air Command, Offutt AFB, NE. Office of thge Historian.
**ICBM ABBREVIATIONS AND ACRONYMS (2ND EDITION)**
1 Jan. 1991 95 p Sponsored by AF
(PB91-193375) Avail: NTIS HC/MF A05 CSCL 05B

The second edition of Intercontinental Ballistic Missile (ICBM) Abbreviations and Acronyms updates and significantly expands the original work. This edition, like the original, covers the terms most commonly used when working with Strategic Air Command (SAC) missiles. The publication is neither a complete missile dictionary nor is it designed to replace information in Air Force Manuals 11-1 or 11-2. Its purpose is to provide quick and easy access to SAC missile terms for staff personnel and researchers. Author

**N91-33012#** Department of Energy, Oak Ridge, TN.
**ENVIRONMENT, SAFETY AND HEALTH THESAURUS/DICTIONARY**
D. C. Clayton, ed. Jul. 1991 510 p
(DE91-013428; DOE/EH-0186) Avail: NTIS HC/MF A22

The Environment, Safety and Health Thesaurus/Dictionary, was developed for the Office of Safety and Quality Assurance (EH-30) by the Department of Energy's (DOE) Office of Scientific and Technical Information (OSTI). This thesaurus/dictionary is to provide a single departmental reference for (1) definitions or semantic structure of environment, safety, and health terms that will help assure consistent DOE-wide understanding of these terms, and (2) synonyms and related terms that will improve the logic of a user's analytical strategy for word searches in computerized environment, safety, and health information systems. In addition to special data fields found within the individual word blocks, the most noteworthy features of the document are the three appendices following the main body of the thesaurus. These appendices include: (1) a listing of all thesaurus acronyms and their reciprocal phrases; (2) a listing of all thesaurus terms under broader subject categories; and (3) a separate mini-thesaurus for the DOE FRASE (Factor Relationship and Sequence of Events) vocabulary used on the Safety Performance Measurement System (SPMS). Eventually, an electronic version of the thesaurus/dictionary will be available on the Safety Performance Measurement System (SPMS) to improve users' search and analytical capabilities. DOE

**N91-33013*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**NASA/DOD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT: PHASE 3 ACADEMIC LIBRARY RESPONDENTS INCLUDING FREQUENCY DISTRIBUTIONS**
**Summary Report**
Thomas E. Pinelli, John M. Kennedy, and Terry F. White (Indiana Univ., Bloomington.) Aug. 1991 41 p Prepared in cooperation with Department of Defense, Washington, DC
(NASA-TM-104095; NAS 1.15:104095; Rept-10) Avail: NTIS HC/MF A03 CSCL 05B

Phase 3 of a 4 part study was undertaken to study the use of scientific and technical information (STI) in the academic aerospace community. Phase 3 of this project used three questionnaires that were sent to three groups (i.e., faculty, librarians, and students) in the academic aerospace community. Specific attention was paid to the types of STI used and the methods in which academic users acquire STI. The responses of the academic libraries are focussed on herein. Demographic information on academic aerospace libraries is provided. Data regarding NASA interaction with academic aerospace libraries is also included, as is the survey instrument. Author

**N91-32369#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**AN OVERVIEW OF THE NASA ELECTRONIC COMPONENTS INFORMATION MANAGEMENT SYSTEM**
G. Kramer and S. Waterbury *In* ESA, ESA Electronic Components Conference Mar. 1991 p 499-502 (For primary document see N91-32291 24-33)
Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32377#** Tecnologica S.A., La Laguna (Spain).
**SPACE FLIGHT COMPONENTS DATABASE [BASE DE DONNEES POUR COMPOSANTS HAUTE FIABILITE]**
Jose M. Galdo and Jose A. Izquierdo *In* ESA, ESA Electronic Components Conference Mar. 1991 p 545-547 In SPANISH (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32380#** Plessey Research (Caswell) Ltd., Towcester (England).
**COMPONENT FIELD FAILURE DATA BASE**
G. M. Brydon and J. A. Hayes (Loughborough Univ. of Technology, England ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 561-565 Sponsored by United Kingdom Ministry of Defence Electronic Components Group (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32381#** National Space Development Agency, Tokyo (Japan). Reliability Assurance Dept.
**A PLAN OF NASDA's PARTS DATABASE IN THE RELIABILITY INFORMATION SYSTEM**
Koichi Shinokazi *In* ESA, ESA Electronic Components Conference Mar. 1991 p 567-568 (For primary document see N91-32291 24-33)
Copyright Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

**N91-32670*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**INTERACTIVE ACCESS AND MANAGEMENT FOR FOUR-DIMENSIONAL ENVIRONMENTAL DATA SETS USING McIDAS**
William L. Hibbard and Gregory J. Tripoli *In its* NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 29-31 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 05B

**N91-32671*#** National Center for Atmospheric Research, Boulder, CO.
**RESEARCH ON DIABATIC INITIALIZATION**
Akira Kasahara *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 33-35 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 05B

# 83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

**N91-33014*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**RELIABILITY AND COST: A SENSITIVITY ANALYSIS**
Ronald C. Suich (California State Univ., Fullerton.) and Richard L. Patterson Oct. 1991 14 p
(Grant NAG3-1100)
(NASA-TM-105293; E-6631; NAS 1.15:105293) Avail: NTIS HC/MF A03 CSCL 05C

In the design phase of a system, how a design engineer or manager choose between a subsystem with .990 reliability and a more costly subsystem with .995 reliability is examined, along with the justification of the increased cost. High reliability is not necessarily an end in itself but may be desirable in order to reduce the expected cost due to subsystem failure. However, this may not be the wisest use of funds since the expected cost due to subsystem failure is not the only cost involved. The subsystem itself may be very costly. The cost of the subsystem nor the expected cost due to subsystem failure should not be considered separately but the total of the two costs should be maximized, i.e., the total of the cost of the subsystem plus the expected cost due to subsystem failure. Author

**N91-32279*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**MODELING PREPARATION COSTS FOR SPACE MISSIONS BY USING MAJOR COST DRIVERS**
J. S. Sherif, D. S. Remer (Harvey Mudd Coll., Claremont, CA.), and H. R. Buchanan *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1991 p 404-415 (For primary document see N91-32250 24-32)
Avail: NTIS HC/MF A18 CSCL 05C

# 84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

**N91-33015#** Norwegian Defence Research Establishment, Kjeller.
**A POLITICAL SCENARIO FOR EUROPE: PAN-EUROPEAN SECURITY SYSTEM**
Hans Myhrengen 23 Apr. 1991 33 p In NORWEGIAN; ENGLISH summary
(FFI-91/5009; ISSN-0802-2437; ETN-91-90054) Avail: NTIS HC/MF A03

Several main features of a possible future European security system based on the concept of common security are outlined. The Conference on Security and Cooperation in Europe (CSCE) is considered to be the most likely framework within which such a system may evolve. The system's capability to solve international conflict without breaking down is considered. ESA

# 85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

**N91-33030*#** California Univ., Irvine.
**BENEFITS TO THE NATION FROM ASTRONOMY AND ASTROPHYSICS**
Virginia Trimble, John N. Bahcall, Eric Chaisson, Arthur Code, Edward K. Conklin, John Cowan, Alexander Dalgarno, Frank Drake, Rebecca Elson, and George Field (Harvard Univ., Cambridge, MA.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 20 p Prepared in cooperation with Maryland Univ., College Park (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 05A

# 88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

# 89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

**N91-33016*#** National Academy of Sciences - National Research Council, Washington, DC. Astronomy and Astrophysics Survey Committee.
**THE DECADE OF DISCOVERY IN ASTRONOMY AND ASTROPHYSICS**
1991 217 p Previously announced in IAA as A91-36824 Sponsored by NASA, Washington Original contains color illustrations
(Contracts DE-FG05-89ER-40421; N00173-90-M-9744; NSF AST-89-01685)
(NASA-CR-188226; NAS 1.26:188226; LC-90-21659;
ISBN-0-309-04381-6) Copyright Avail: NTIS HC/MF A10; 20 functional color pages CSCL 03A

A survey of astronomy and astrophysics in the 1990s is presented and a prioritized agenda is offered for space- and ground-based research into the 21st century. In addition to proposing new telescopes for ground and space, the research infrastructure is discussed. The urgent need is emphasized for increased support of individual investigators, for appropriate maintenance and refurbishment of existing facilities, and for a balanced program of space astronomy. The scientific and the technical opportunities of the 1990s are summarized and the technological development is described needed for instruments to be built in the first years of the next century. Also addressed is the suitability of the Moon as an observation site. Author

**N91-33017*#** National Academy of Sciences - National Research Council, Washington, DC.
**WORKING PAPERS: ASTRONOMY AND ASTROPHYSICS PANEL REPORTS**
John N. Bahcall, Charles A. Beichman, Claude Canizares, James Cronin, David Heeschen, James Houck, Donald Hunten, Christopher F. McKee, Robert Noyes, and Jeremiah P. Ostriker (Princeton Univ. Observatory, NJ.) et al 1991 345 p Sponsored in part by the Smithsonian Inst.
(Contracts DE-FG05-89ER-40421; N00173-90-M-9744; NSF AST-89-01685)
(NASA-CR-188785; NAS 1.26:188785; LC-90-63608;
ISBN-0-309-04383-2) Avail: NTIS HC/MF A15 CSCL 03A

The papers of the panels appointed by the Astronomy and Astrophysics survey Committee are compiled. These papers were advisory to the survey committee and represent the opinions of the members of each panel in the context of their individual charges. The following subject areas are covered: radio astronomy, infrared astronomy, optical/IR from ground, UV-optical from space, interferometry, high energy from space, particle astrophysics, theory and laboratory astrophysics, solar astronomy, planetary astronomy, computing and data processing, policy opportunities, benefits to

the nation from astronomy and astrophysics, status of the profession, and science opportunities. For individual titles, see N91-33018 through N91-33031.

**N91-33018*#** National Radio Astronomy Observatory, Charlottesville, VA.
**RADIO ASTRONOMY**
Kenneth I. Kellermann, David Heeschen, Donald C. Backer, Marshall H. Cohen, Michael Davis, Imke DePater, David DeYoung, George A. Dulk (Colorado Univ., Boulder.), J. R. Fisher, and W. Miller Goss et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 23 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

The following subject areas are covered: (1) scientific opportunities (millimeter and sub-millimeter wavelength astronomy; meter to hectometer astronomy; the Sun, stars, pulsars, interstellar masers, and extrasolar planets; the planets, asteroids, and comets; radio galaxies, quasars, and cosmology; and challenges for radio astronomy in the 1990's); (2) recommendations for new facilities (the millimeter arrays, medium scale instruments, and small-scale projects); (3) continuing activities and maintenance, upgrading of telescopes and instrumentation; (4) long range programs and technology development; and (5) social, political, and organizational considerations. Author

**N91-33019*#** National Optical Astronomy Lab. Tucson, AZ.
**INFRARED ASTRONOMY**
Frederick Gillett, James Houck, John Bally, Eric Becklin, Robert Hamilton Brown, Bruce Draine, Jay Frogel, Ian Gatley, Robert Gehrz, and Roger Hildebrand (Chicago Univ., IL.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 21 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

The decade of 1990's presents an opportunity to address fundamental astrophysical issues through observations at IR wavelengths made possible by technological and scientific advances during the last decade. The major elements of recommended program are: the Space Infrared Telescope Facility (SIRTF), the Stratospheric Observatory For Infrared Astronomy (SOFIA) and the IR Optimized 8-m Telescope (IRO), a detector and instrumentation program, the SubMilliMeter Mission (SMMM), the 2 Microns All Sky Survey (2MASS), a sound infrastructure, and technology development programs. Also presented are: perspective, science opportunities, technical overview, project recommendations, future directions, and infrastructure. Author

**N91-33020*#** Massachusetts Inst. of Tech., Cambridge.
**OPTICAL/IR FROM GROUND**
Stephen Strom, Wallace L. W. Sargent, Sidney Wolff, Michael F. AHearn, J. Roger Angel, Steven V. W. Beckwith, Bruce W. Carney, Peter S. Conti, Suzan Edwards, and Gary Grasdalen (Wyoming Univ., Laramie.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 28 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

Optical/infrared (O/IR) astronomy in the 1990's is reviewed. The following subject areas are included: research environment; science opportunities; technical development of the 1980's and opportunities for the 1990's; and ground-based O/IR astronomy outside the U.S. Recommendations are presented for: (1) large scale programs (Priority 1: a coordinated program for large O/IR telescopes); (2) medium scale programs (Priority 1: a coordinated program for high angular resolution; Priority 2: a new generation of 4-m class telescopes); (3) small scale programs (Priority 1: near-IR and optical all-sky surveys; Priority 2: a National Astrometric Facility); and (4) infrastructure issues (develop, purchase, and distribute optical CCDs and infrared arrays; a program to support large optics technology; a new generation of large filled aperture telescopes; a program to archive and disseminate astronomical databases; and a program for training new instrumentalists) Author

**N91-33021*#** California Univ., Santa Cruz.
**UV-OPTICAL FROM SPACE**
Garth Illingworth, Blair Savage, J. Roger Angel, Roger D. Blandford, Albert Boggess, C. Stuart Bowyer, George R. Carruthers, Lennox L. Cowie, George A. Doschek, and Andrea K. Dupree (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 31 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

The following subject areas are covered: (1) the science program (star formation and origins of planetary systems; structure and evolution of the interstellar medium; stellar population; the galactic and extragalactic distance scale; nature of galaxy nuclei, AGNs, and QSOs; formation and evolution of galaxies at high redshifts; and cosmology); (2) implementation of the science program; (3) the observatory-class missions (HST; LST - the 6m successor to HST; and next-generation 16m telescope); (4) moderate and small missions (Delta-class Explorers; imaging astrometric interferometer; small Explorers; optics development and demonstrations; and supporting ground-based capabilities); (5) prerequisites - the current science program (Lyman-FUSE; HTS optimization; the near-term science program; data analysis, modeling, and theory funding; and archives); (6) technologies for the next century; and (7) lunar-based telescopes and instruments. Author

**N91-33022*#** National Optical Astronomy Lab. Tucson, AZ.
**INTERFEROMETRY**
Stephen Ridgway, Robert W. Wilson, Mitchell C. Begelman, Peter Bender, Bernard F. Burke, Tim Cornwell, Ronald Drever, H. Melvin Dyck, Kenneth J. Johnston, and Edward Kibblewhite (Chicago Univ., IL.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 22 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

The following recommended programs are reviewed: (1) infrared and optical interferometry (a ground-based and space programs); (2) compensation for the atmosphere with adaptive optics (a program for development and implementation of adaptive optics); and (3) gravitational waves (high frequency gravitational wave sources (LIGO), low frequency gravitational wave sources (LAGOS), a gravitational wave observatory program, laser gravitational wave observatory in space, and technology development during the 1990's). Prospects for international collaboration and related issues are also discussed. Author

**N91-33023*#** Washington Univ., Seattle.
**HIGH ENERGY FROM SPACE**
Bruce Margon, Claude Canizares, Richard C. Catura, George W. Clark, Carl E. Fichtel, Herbert Friedman, Riccardo Giacconi, Jonathan E. Grindlay, David J. Helfand, and Stephen S. Holt (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 24 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

The following subject areas are covered: (1) important scientific problems for high energy astrophysics (stellar activity, the interstellar medium in galaxies, supernovae and endpoints of stellar evolution, nucleosynthesis, relativistic plasmas and matter under extreme conditions, nature of gamma-bursts, identification of black holes, active nuclei, accretion physics, large-scale structures, intracluster medium, nature of dark matter, and the X- and gamma-ray background); (2) the existing experimental programs (Advanced X-Ray Astrophysics Facility (AXAF), Gamma Ray Observatory (GRO), X-Ray Timing Explorer (XTE), High Energy

Transient Experiment (HETE), U.S. participation in foreign missions, and attached Shuttle and Space Station Freedom payloads); (3) major missions for the 1990's; (4) a new program of moderate missions; (5) new opportunities for small missions; (6) technology development issues; and (7) policy issues. Author

**N91-33024*#** California Univ., Berkeley.
**PARTICLE ASTROPHYSICS** **c90**
Bernard Sadoulet, James Cronin, Elena Aprile, Barry C. Barish, Eugene W. Beier, Robert Brandenberger, Blas Cabrera, David Caldwell, George Cassiday, and David B. Cline (California Univ., Los Angeles.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 23 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03B

The following scientific areas are reviewed: (1) cosmology and particle physics (particle physics and the early universe, dark matter, and other relics); (2) stellar physics and particles (solar neutrinos, supernovae, and unconventional particle physics); (3) high energy gamma ray and neutrino astronomy; (4) cosmic rays (space and ground observations). Highest scientific priorities for the next decade include implementation of the current program, new initiatives, and longer-term programs. Essential technological developments, such as cryogenic detectors of particles, new solar neutrino techniques, and new extensive air shower detectors, are discussed. Also a certain number of institutional issues (the funding of particle astrophysics, recommended funding mechanisms, recommended facilities, international collaborations, and education and technology) which will become critical in the coming decade are presented. Author

**N91-33025*#** Chicago Univ., IL.
**THEORY AND LABORATORY ASTROPHYSICS** **c90**
David N. Schramm, Christopher F. McKee, Charles Alcock, Lou Allamandola, Roger A. Chevalier, David B. Cline, Alexander Dalgarno, Bruce G. Elmegreen, S. Michael Fall, and Gary J. Ferland (Ohio State Univ., Columbus.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 22 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03B

Science opportunities in the 1990's are discussed. Topics covered include the large scale structure of the universe, galaxies, stars, star formation and the interstellar medium, high energy astrophysics, and the solar system. Laboratory astrophysics in the 1990's is briefly surveyed, covering such topics as molecular, atomic, optical, nuclear and optical physics. Funding recommendations are given for the National Science Foundation, NASA, and the Department of Energy. Recommendations for laboratory astrophysics research are given. Author

**N91-33026*#** Chicago Univ., IL.
**SOLAR ASTRONOMY**
Robert Rosner, Robert Noyes, Spiro K. Antiochos, Richard C. Canfield, Edward L. Chupp, Drake Deming, George A. Doschek, George A. Dulk, Peter V. Foukal, and Ronald L. Gilliland (Space Telescope Science Inst., Baltimore, MD.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 35 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

An overview is given of modern solar physics. Topics covered include the solar interior, the solar surface, the solar atmosphere, the Large Earth-based Solar Telescope (LEST), the Orbiting Solar Laboratory, the High Energy Solar Physics mission, the Space Exploration Initiative, solar-terrestrial physics, and adaptive optics. Policy and related programmatic recommendations are given for university research and education, facilitating solar research, and integrated support for solar research. Author

**N91-33027*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**PLANETARY ASTRONOMY**
David Morrison, Donald Hunten, Michael F. AHearn, Michael J. S. Belton, David Black, Robert A. Brown, Robert Hamilton Brown, Anita L. Cochran, Dale P. Cruikshank, and Imke DePater (California Univ., Berkeley.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 21 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

The authors profile the field of astronomy, identify some of the key scientific questions that can be addressed during the decade of the 1990's, and recommend several facilities that are critically important for answering these questions. Scientific opportunities for the 1990' are discussed. Areas discussed include protoplanetary disks, an inventory of the solar system, primitive material in the solar system, the dynamics of planetary atmospheres, planetary rings and ring dynamics, the composition and structure of the atmospheres of giant planets, the volcanoes of IO, and the mineralogy of the Martian surface. Critical technology developments, proposed projects and facilities, and recommendations for research and facilities are discussed.

Author

**N91-33028*#** Illinois Univ., Urbana-Champaign.
**COMPUTING AND DATA PROCESSING** **c61**
Larry Smarr, William Press, David W. Arnett, Alastair G. W. Cameron, Richard M. Crutcher, David J. Helfand, Paul Horowitz, Susan G. Kleinmann, Jeffrey L. Linsky, and Barry F. Madore (California Inst. of Tech., Pasadena.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 25 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 09B

The applications of computers and data processing to astronomy are discussed. Among the topics covered are the emerging national information infrastructure, workstations and supercomputers, supertelescopes, digital astronomy, astrophysics in a numerical laboratory, community software, archiving of ground-based observations, dynamical simulations of complex systems, plasma astrophysics, and the remote control of fourth dimension supercomputers. Author

**N91-33029*#** Colorado Univ., Boulder.
**POLICY OPPORTUNITIES**
Richard McCray, Jeremiah P. Ostriker, Loren W. Acton, Neta A. Bahcall, Robert C. Bless, Robert A. Brown, Geoffrey Burbidge, Bernard F. Burke, George W. Clark, and France A. Cordova (Pennsylvania State Univ., University Park.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 18 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

Recommendations are given regarding National Science Foundation (NSF) astronomy programs and the NASA Space Astrophysics program. The role of ground based astronomy is reviewed. The role of National Optical Astronomy Observatories (NOAO) in ground-based night-time astronomical research is discussed. An enhanced Explored Program, costs and management of small and moderate space programs, the role of astrophysics within NASA's space exploration initiative, suborbital and airborne astronomical research, the problems of the Hubble Space Telescope, and astronomy education are discussed. Also covered are policy issues related to the role of science advisory committees, international cooperation and competition, archiving and distribution of astronomical data, and multi-wavelength observations of variable sources. Author

**N91-33030*#** California Univ., Irvine.
**BENEFITS TO THE NATION FROM ASTRONOMY AND ASTROPHYSICS** **c85**
Virginia Trimble, John N. Bahcall, Eric Chaisson, Arthur Code,

Edward K. Conklin, John Cowan, Alexander Dalgarno, Frank Drake, Rebecca Elson, and George Field (Harvard Univ., Cambridge, MA.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 20 p Prepared in cooperation with Maryland Univ., College Park (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 05A

It is argued that astronomy makes unexpectantly large contributions to formal and informal science education, given the small number of research astronomers. Technology transfer and spin-offs from astronomy have important applications in medicine, industry, defence, environmental monitoring, and consumer products. Astronomy provides unusually promising opportunities for international cooperation. Other sciences benefit from synergistic interactions with astronomy. A review is given of astronomy education and teacher training. The role of astronomy in medicine, industry, defence, energy technology, the environment, and everyday life is reviewed. Author

**N91-33031*#** American Astronomical Society, Washington, DC.
**STATUS OF THE PROFESSION**
Peter B. Boyce, Charles A. Beichman, Helmut A. Abt, Wendy Hagen Bauer, Geoffrey Burbidge, Anita L. Cochran, Robert Dorfman, Hugh Harris, Robert Havlen, and Christine Jones (Smithsonian Astrophysical Observatory, Cambridge, MA.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 19 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03A

The number of astronomers has grown by about 40 percent over the past decade. The number of astronomers with jobs in industry, or with long-term, non-tenured, jobs has increased dramatically compared with traditional faculty positions. The increase in the number of astronomers and the declining share of the NSF budget going to astronomy has led to extreme difficulties in the NSF grant program and in support of the National Observatories. In 1989, direct NASA support of astronomers through the grants program exceeds that of NSF, although the total of the NSF grants program over decade far exceeds that of NASA. Access to major new telescopes will be important issue for the 1990s. US astronomers, who once had a monopoly on telescopes larger than 3 meters, will, by the year 2000, have access to just half of the world's optical telescope area. Author

**N91-33032#** Fermi National Accelerator Lab., Batavia, IL.
**DESIGN OF THE DIGITAL SKY SURVEY DA AND ONLINE SYSTEM: A CASE HISTORY IN THE USE OF COMPUTER AIDED TOOLS FOR DATA ACQUISITION SYSTEM DESIGN**
D. Petravick, E. Berman, T. Nicinski, R. Rechenmacher, G. Oleynik, R. Pordes, and C. Stoughton Jun. 1991 4 p Presented at the 7th International Conference on Real Time Computer Applications in Nuclear, Particle and Plasma Physics, Juelich (Germany), 18-21 Jun. 1991
(Contract DE-AC02-76CH-03000)
(DE91-016469; FNAL/C-91/173; CONF-9106122-4) Avail: NTIS HC/MF A01

As part of its expanding Astrophysics program, Fermilab is participating in the Digital Sky Survey (DSS). Fermilab is part of a collaboration involving University of Chicago, Princeton University, and the Institute of Advanced Studies (at Princeton). The DSS main results will be a photometric imaging survey and a redshift survey of galaxies and color-selected quasars over pi steradians of the Northern Galactic Cap. This paper focuses on our use of Computer Aided Software Engineering (CASE) in specifying the data system for DSS. Extensions to standard methodologies were necessary to compensate for tool shortcomings and to improve communication amongst the collaboration members. One such important extension was the incorporation of CASE information into the specification document. DOE

**N91-33033*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**SOFIA: A STRATOSPHERIC OBSERVATORY FOR INFRARED ASTRONOMY Final Report**
E. F. Erickson, J. A. Davidson, G. Thorley, and L. J. Caroff (National Aeronautics and Space Administration, Washington, DC.) Aug. 1991 26 p Original contains color illustrations
(NASA-TM-103840; A-91076; NAS 1.15:103840) Avail: NTIS HC/MF A03; 8 functional color pages CSCL 03A

SOFIA is described as it was originally (May 1988) for the Space and Earth Sciences Advisory Committee (SESAC). The format and questions were provided by SESAC as a standard for judging the merit of potential U.S. space science projects. This version deletes Section IIF, which addressed development costs of the SOFIA facility. SOFIA's unique astronomical potential is described and it is shown how it complements and supports existing and planned facilities. Author

**N91-33034#** European Space Agency, Paris (France).
**INDIRECT IMAGING THROUGH THE ATMOSPHERE**
Alain Seve (Office National d'Etudes et de Recherches Aerospatiales, Paris, France ) May 1991 199 p Transl. into ENGLISH of De Quelques Methodes d'Imagerie Indirecte a Travers l'Atmosphere (Paris, France, ONERA), 1987 p 1-154 Original language document was announced as N88-27124
(ESA-TT-1115; ONERA-NT-1987-4; ETN-88-92728; ETN-91-90074) Avail: NTIS HC/MF A09

High resolution imaging through the atmosphere is considered. The different speckle methods are reviewed, and two of them, the speckle interferometry technique and the Knox-Thompson algorithm are studied in detail. The main maximum likelihood algorithms are reviewed and compared. These various methods were applied to astronomical and simulated data and some results are presented. ESA

# 90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

**N91-33035** Michigan Univ., Ann Arbor.
**EXAM: A SEARCH FOR EXTRAGALACTIC ANTIMATTER Ph.D. Thesis**
David James Crary 1991 146 p
Avail: Univ. Microfilms Order No. DA9124001

Results from a search for extragalactic antimatter in the cosmic rays (the EXAM experiment) are presented. The reasons for undertaking a search for antimatter are given, along with various arguments that indicate that an antimatter fraction of 10(exp -6) - 10(exp -7) in the cosmic ray flux at earth would not be inconsistent with current antimatter limits obtained from cosmic ray experiments or with limits set by gamma-ray observations. An experimental technique sensitive to antinuclei with charge Z near iron (Z = 26) is reviewed. This technique uses a combination of active detectors (scintillators, Cerenkov counters) and CR-39 track etch detectors to provide a unique signature for antimatter detection at a level consistent with the flux estimates given above. This is followed by description of the implementation of this technique (the EXAM detector), along with a summary of the data analysis to date. Directions for future work are described. A detailed description of the microscope system used in the automated analysis of the CR-39 plastic is presented. Dissert. Abstr.

**N91-33036** Arizona Univ., Tucson.
**ATMOSPHERES OF COMETS: GAS DYNAMIC MODELS AND INFERENCE OF KINEMATIC PARAMETERS Ph.D. Thesis**
Hong-Yao Hu 1991 179 p
Avail: Univ. Microfilms Order No. DA9123480

Cometary nuclei may be the best available probes of the physical and chemical nature of the presolar nebula. However, in situ sampling of cometary nuclei to determine their composition is

generally not feasible. Instead, remote spectroscopic observations of cometary comae are used to infer cometary composition. This approach relies on one's ability to model accurately the density distributions of gas and dust in the comae and a complex network of photochemical and molecular processes. Previously, a variety of theoretical models had been developed and, unfortunately, they are applicable only to a portion of the coma or to specific problems. A preliminary version of a gas model is introduced which is built upon the concepts of dilute gas theory. This model is valid over the whole coma and it incorporates all previous models as its special cases, thus providing a new theoretical foundation for future cometary studies. A spectral outflow model is discussed. This model is a special case of the dilute gas model and is tailored specifically to retrieve kinematic properties of cometary comae from velocity resolved spectral line profiles. The formation is reviewed of cometary spectral line profiles and an analytic expression is developed that maps 3-D number density distributions into synthetic spectral line profiles. After discussing simplifications and Monte Carlo computational procedures, the spectral outflow model is applied to interpret infrared observations of H2O in comets Halley and Wilson. Dissert. Abstr.

**N91-33037** Washington Univ., Seattle.
**COALESCING BINARY SYSTEMS OF COMPACT OBJECTS TO (POST) SUP 5/2 NEWTONIAN ORDER: LATE-TIME EVOLUTION AND GRAVITATIONAL RADIATION EMISSION**
**Ph.D. Thesis**
Craig Walter Lincoln 1990 91 p
Avail: Univ. Microfilms Order No. DA9122393

The late time evolution of binary systems of compact objects (neutron stars or black holes) is studied using the Damour-Deruelle (post) sup 5/2 Newtonian equations of motion with relativistic corrections of all orders up to and including radiation reaction. Using the method of osculating orbital elements from celestial mechanics, the orbits are evolved to separations of r approx. = 2 m, where m is the total mass, at which point the (post) sup 5/2 Newtonian approximation breaks down. With the orbits as input, the gravitational waveform and luminosity are calculated using a post Newtonian formalism of Wagoner and Will. Results are obtained for systems containing various combinations of compact objects, for various values of the mass ratio m sub 1/m sub 2, and for various initial values of the orbital eccentricity.
Dissert. Abstr.

**N91-33038#** Lawrence Livermore National Lab., CA.
**NUCLEAR AND ASTRONOMICAL CONSTRAINTS ON THE SITE FOR R-PROCESS NUCLEOSYNTHESIS**
G. J. Mathews, G. Bazan, and J. J. Cowan (Oklahoma Univ., Norman.) Jun. 1991 15 p Presented at the 7th International Symposium on Capture Gamma Ray Spectroscopy and Related Topics, Pacific Grove, CA, 14-19 Oct. 1990
(Contract W-7405-eng-48)
(DE91-016561; UCRL-JC-105034; CONF-901057-30) Avail: NTIS HC/MF A03

New measurements and theoretical studies of nuclear properties, together with new astronomical data on the growth of heavy-element abundances during the early history of the Galaxy, now provide a clearer picture of where in nature the elements heavier than iron are produced by rapid (r-process) neutron capture reactions. The nuclear data suggest that the r-process involves a high-temperature and high-neutron-density beta-flow equilibrium environment. The astronomical data, when compared with simple galactic chemical evolution models, suggests that the r-process is associated with Type 2 supernovae and that the neutron source must be manufactured by the star independent of the initial heavy element abundance. Low-mass type 2 supernovae are proposed as the most important contributors to the r-process. DOE

**N91-33039#** Lawrence Livermore National Lab., CA.
**ASTROPHYSICAL NEUTRON CAPTURE PROCESSES**
G. Bazan (Illinois Univ., Urbana.) 18 Jul. 1991 6 p
(Contract W-7405-eng-48)
(DE91-017071; UCRL-CR-107841) Avail: NTIS HC/MF A02

The production of half of the isotopes from iron to lead has been attributed to a process involving the neutron captures on iron peak nuclei. The timescales on which the captures occur is of the order of beta-decay timescales of nuclei not far from beta-stability. This is known as the s-process. In recent years, the thermal pulsation stage of asymptotic giant branch (AGB) stars has been thought to be the astrophysical site in which this neutron production and capture could happen. Recent models of such stars have provided evidence for different neutron sources than what previously had been believed. In addition, past studies of the old models had seemingly neglected the presence of various physical phenomena such as convective mixing and time dependent parameters, such as the retreat of the convective shell, that could eventually effect the final isotope distribution. We have made a realistic look at the entire mass range of thermally pulsing AGB stars as the sole site of s-process isotopes. DOE

**N91-33040#** Fermi National Accelerator Lab., Batavia, IL.
**TESTING THE BIG BANG: LIGHT ELEMENTS, NEUTRINOS, DARK MATTER, AND LARGE-SCALE STRUCTURE**
David N. Schramm (Chicago Univ., IL.) Jun. 1991 28 p Presented at the 2nd Winter School of Physics, San Juan (Puerto Rico), 28 Mar. - 5 Apr. 1991
(Contract DE-AC02-76CH-03000)
(DE91-017379; FNAL/C-91/179-A; CONF-9103197-1) Avail: NTIS HC/MF A03

In this series of lectures, several experimental and observational tests of the standard cosmological model are examined. In particular, detailed discussion is presented regarding: (1) nucleosynthesis, the light element abundances, and neutrino counting; (2) the dark matter problems; and (3) the formation of galaxies and large-scale structure. Comments will also be made on the possible implications of the recent solar neutrino experimental results for cosmology. An appendix briefly discusses the 17 keV thing and the cosmological and astrophysical constraints on it. DOE

**N91-33041#** Delaware Univ., Newark.
**PARTICLE THEORY AND COSMOLOGY**
T. K. Gaisser, Q. Shafi, S. M. Barr, D. Seckel, E. Rusjan, and R. S. Fletcher 31 Jul. 1991 24 p
(Contract DE-FG02-91ER-40626)
(DE91-017730; DOE/ER-40626/1) Avail: NTIS HC/MF A03

This report discusses research of professor at Bartol Research Institute in the following general areas: particle phenomenology and non-accelerator physics; particle physics and cosmology; theories with higher symmetry; and particle astrophysics and cosmology. DOE

**N91-33024*#** California Univ., Berkeley.
**PARTICLE ASTROPHYSICS**
Bernard Sadoulet, James Cronin, Elena Aprile, Barry C. Barish, Eugene W. Beier, Robert Brandenberger, Blas Cabrera, David Caldwell, George Cassiday, and David B. Cline (California Univ., Los Angeles.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 23 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03B

**N91-33025*#** Chicago Univ., IL.
**THEORY AND LABORATORY ASTROPHYSICS**
David N. Schramm, Christopher F. McKee, Charles Alcock, Lou Allamandola, Roger A. Chevalier, David B. Cline, Alexander Dalgarno, Bruce G. Elmegreen, S. Michael Fall, and Gary J. Ferland (Ohio State Univ., Columbus.) et al *In* National Academy of Sciences/National Research Council, Working Papers: Astronomy and Astrophysics Panel Reports 1991 22 p (For primary document see N91-33017 24-89)
Avail: NTIS HC/MF A15 CSCL 03B

# 91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

**N91-33042*#** Michigan Univ., Ann Arbor. Dept. of Atmospheric, Oceanic and Space Sciences.
**VERTICAL MIXING AND METHANE PHOTOCHEMISTRY IN THE ATMOSPHERE OF URANUS: ANALYSIS OF VOYAGER UVS OCCULTATION EXPERIMENTS Final Report, 1 Oct. 1988 - 31 May 1991**
James Bishop 25 Sep. 1991 13 p
(Grant NAGw-1504)
(NASA-CR-188789; NAS 1.26:188789) Avail: NTIS HC/MF A03 CSCL 03B

Extensive capabilities were developed in the analysis of ultraviolet spectrometer (UVS) absorptive lightcurves. The application of these capabilities to the Voyager UVS data sets from Uranus and Neptune has provided significant findings regarding the stratospheres of these planets. In particular, the direct comparison between photochemical models and UVS measurements accomplished by these efforts is unique, and it helps to guarantee that the information returned by the Voyager 2 spacecraft is being used to the fullest extent possible. Author

**N91-33043*#** Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
**HIGH RESOLUTION MEASUREMENTS OF DENSITY STRUCTURES IN THE JOVIAN PLASMA SHEET**
J. A. Ansher, W. S. Kurth, D. A. Gurnett, and C. K. Goertz Jul. 1991 17 p
(Contract JPL-957723)
(NASA-CR-188918; NAS 1.26:188918; U-of-Iowa-91-18) Avail: NTIS HC/MF A03 CSCL 03B

A recent effort to digitize the plasma density by using the low frequency cutoff of trapped continuum radiation in the vicinity of the Jovian plasma sheet has revealed the existence of sharply defined density structures in the plasma sheet. These structures typically have a plasma density which is relatively constant but of order 50 percent greater or less than in the surrounding plasma. At the boundaries of these structures, the transitions from low to high density occur on time scales of about ten seconds, which correspond to spatial dimensions on the order of a few ion Larmor radii. The structures themselves last for intervals from less than a minute to more than five minutes, corresponding to size scales from a fraction of a Jovian radius to more than a Jovian radius, depending of the velocity of the structure relative to the spacecraft. In view of the importance of near corotation plasma flows, these structures are likely to be limited in both the longitudinal and radial dimensions and, therefore, could represent flux tubes with greatly varying plasma content. These observations are presented as among the first to directly address the theoretically proposed interchange instability. Author

**N91-33044#** Bureau of Mines, Washington, DC.
**MINING TECHNOLOGY FOR LUNAR RESOURCE UTILIZATION**
J. A. Siekmeier and E. R. Podnieks Jul. 1990 75 p
(PB91-201020) Avail: NTIS HC/MF A04 CSCL 03B

Some of the basic issues that must be considered when designing a lunar mining system are outlined. A surface mining scenario is proposed which emphasizes teleoperated and automated mobile equipment. Equipment flexibility and synergism are considered paramount to allow the equipment to mine a variety of resource deposits as well as enable the mining equipment to be used as supportive construction equipment. The surface mining scenario involves the following operations: erecting prefabricated structures at the processing site; excavating regolith from an open pit; transporting and beneficiating the mined materials; extracting oxygen and hydrogen; and disposing of tailings. The lunar atmosphere and ground conditions contrast sharply with the terrestrial environment. These effects must be included in every design consideration related to lunar mining. Author

**N91-33045*#** Georgia Inst. of Tech., Atlanta. School of Earth and Atmospheric Sciences.
**ADDITIONS TO MARS GLOBAL REFERENCE ATMOSPHERIC MODEL (MARS-GRAM) Semiannual Technical Report**
C. G. Justus Oct. 1991 35 p
(Grant NAG8-877)
(NASA-CR-188924; NAS 1.26:188924) Avail: NTIS HC/MF A03 CSCL 03B

Three major additions or modifications were made to the Mars Global Reference Atmospheric Model (Mars-GRAM): (1) in addition to the interactive version, a new batch version is available, which uses NAMELIST input, and is completely modular, so that the main driver program can easily be replaced by any calling program, such as a trajectory simulation program; (2) both the interactive and batch versions now have an option for treating local-scale dust storm effects, rather than just the global-scale dust storms in the original Mars-GRAM; and (3) the Zurek wave perturbation model was added, to simulate the effects of tidal perturbations, in addition to the random (mountain wave) perturbation model of the original Mars-GRAM. A minor modification has also been made which allows heights to go below local terrain height and return realistic pressure, density, and temperature (not the surface values) as returned by the original Mars-GRAM. This feature will allow simulations of Mars rover paths which might go into local valley areas which lie below the average height of the present, rather coarse-resolution, terrain height data used by Mars-GRAM. Sample input and output of both the interactive and batch version of Mars-GRAM are presented. Author

**N91-32675*#** Colorado Univ., Boulder. Dept. of Astrophysical, Planetary, and Atmospheric Sciences.
**LABORATORY AND THEORETICAL MODELS OF PLANETARY-SCALE INSTABILITIES AND WAVES Abstract Only**
John E. Hart and Juri Toomre *In* NASA. Marshall Space Flight Center, NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review Sep. 1991 p 47 (For primary document see N91-32660 24-47)
Avail: NTIS HC/MF A05 CSCL 03B

# 92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

**N91-33046*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**SOLAR RADIATION ON MARS: UPDATE 1991**
Joseph Appelbaum and Geoffrey A. Landis (Sverdrup Technology, Inc., Brook Park, OH.) Sep. 1991 48 p Presented at the European Space Power Conference, Florence, Italy, 2-6 Sep. 1991; sponsored by ESA
(Contract NAS3-25266; NAGw-2022)
(NASA-TM-105216; E-6465; NAS 1.15:105216) Avail: NTIS HC/MF A03 CSCL 03B

Detailed information on solar radiation characteristics on Mars are necessary for effective design of future planned solar energy systems operating on the surface of Mars. A procedure and solar radiation related data are presented from which the daily variation of the global, direct beam and diffuse insolation on Mars are calculated. Given the optical depth of the Mars atmosphere, the global radiation is calculated from the normalized net flux function based on multiple wavelength and multiple scattering of the solar radiation. The direct beam was derived from the optical depth using Beer's law, and the diffuse component was obtained from the difference of the global and the direct beam radiation. The optical depths of the Mars atmosphere were derived from images

taken of the Sun with a special diode on the cameras used on the two Viking Landers. Author

**N91-33047#** National Geophysical Data Center, Boulder, CO.
**SOLAR-GEOPHYSICAL DATA NUMBER 560, APRIL 1991. PART 1: (PROMPT REPORTS). DATA FOR MARCH, FEBRUARY 1991, AND LATE DATA**
Helen E. Coffey Apr. 1991 166 p
(PB91-193508; SGD-560-Pt-1) Avail: NTIS HC/MF A08 CSCL 03B

A detailed index is presented for 1990 to 1991. Data for March 1991 includes data on solar terrestrial environment, IUWDS alert periods (Advance and Worldwide), solar activity indices, solar flares, solar radio emission, and Stanford mean solar magnetic field. Data for February 1991 include solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, and geomagnetic indices. Late data include cosmic ray measurements by neutron monitor at Thule from Dec. 1990 to Jan. 1991. Author

**N91-33048#** National Geophysical Data Center, Boulder, CO.
**SOLAR-GEOPHYSICAL DATA NUMBER 560, APRIL 1991. PART 2: (COMPREHENSIVE REPORTS). DATA FOR OCTOBER 1990 AND MISCELLANEOUS**
Helen E. Coffey Apr. 1991 85 p
(PB91-193516; SGD-560-Pt-2) Avail: NTIS HC/MF A05 CSCL 03B

A detailed index is presented for 1990 to 1991. Data is included for October 1990. Included are data on solar flares, solar radio bursts at fixed frequencies, solar x ray radiation from GOES satellite, mass ejections from the sun, active prominences and filaments. Author

**N91-33049#** Los Alamos National Lab., NM.
**SOLAR PARTICLE EVENTS DURING THE RISING PHASE OF SOLAR CYCLE 22**
R. C. Reedy, T. E. Cayton, R. D. Belian, S. P. Gary, G. R. Gisler, G. D. Reeves, T. A. Fritz, and R. A. Christensen 1991 6 p Presented at the Workshop on Ionizing Radiation Environment Models and Methods, Huntsville, AL, 16-18 Apr. 1991
(Contract W-7405-eng-36)
(DE91-016042; LA-UR-91-2267; CONF-9104288-1) Avail: NTIS HC/MF A02

The solar energetic particle events since early 1989 have been among the most intense and hardest in almost three decades. These particles were measured by several Los Alamos instruments on satellites in geosynchronous orbit. Proton fluxes and spectral slopes as measured by the CPA instrument are reported for 1989 and 1990. The composition of heavy (Z approximately equal to 6-28) energetic (approximately equal to 2-50 MeV) ions as measured by the SOPA instrument is presented for the October 1989 event. DOE

# 93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

**N91-33050** Illinois Univ., Urbana-Champaign.
**ASYMMETRIES IN EXTRAGALACTIC RADIO SOURCES Ph.D. Thesis**
Dinshaw S. Balsara 1991 302 p
Avail: Univ. Microfilms Order No. DA9124381

The purpose was to explore computationally the 3-D hydrodynamics of extragalactic radio jets. This entailed putting together a large number of numerical tools before such simulations could be performed. Three chapters on numerical techniques are presented testing out both particle and grid-based methods for computational fluid dynamics. Four chapters of astrophysical applications are then presented which: (1) consider the flow of a supersonic jet in a transonic cross-wind as a model for narrow angle tails; (2) consider jet-shock interactions as a model for wide angle tails; (3) try out jet-cloud interactions as a model for the largest of wide angle tails; and (4) use wall-jets as a model for hot spot formation. Dissert. Abstr.

**N91-33051#** Lawrence Livermore National Lab., CA.
**BARYON INHOMOGENEITY FROM THE COSMIC QUARK-HADRON PHASE TRANSITION**
H. Kurki-Suonio 16 Jul. 1991 10 p Presented at the Workshop on Strange Quark Matter in Physics and Astrophysics, Aarhus (Denmark), 20-24 May 1991
(Contract W-7405-eng-48)
(DE91-016608; UCRL-JC-107980; CONF-9105243-2) Avail: NTIS HC/MF A02

We discuss the generation of inhomogeneity in the baryon-number density during the cosmic quark-hadron phase transition. We use a simple model with thin-wall phase boundaries and ideal-gas equations of state. The nucleation of the phase transition introduces a new distance scale into the universe which will be the scale of the generated inhomogeneity. We review the estimate of this scale. During the transition baryon number is likely to collect onto a layer at the phase boundary. These layers may in the end be deposited as small regions of very high baryon density. DOE

**N91-32349#** Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et Recherches en Technologie Spatiale.
**SINGLE EVENT EFFECTS BY PROTONS ON LOW EARTH ORBITS: A PROBLEM FOR EUROPEAN MANNED SPACE MISSIONS**
J. Bourrieau and T. Bion (MATRA Harris Semiconducteurs, Nantes, France ) *In* ESA, ESA Electronic Components Conference Mar. 1991 p 369-376 (For primary document see N91-32291 24-33)
Avail: NTIS HC/MF A25; EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

# 99 GENERAL

**N91-33052** Technische Univ., Hanover (Germany, F.R.). Dezernat fuer Planung, Statistik und Information.
**[HANOVER UNIVERSITY RESEARCH REPORT] Status Report, 1 Oct. 1988 - 3 Sep. 1990 [HANNOVER UNI FORSCHUNGSBERICHT. BERICHTSZEITRAUM: 1. OKTOBER 1988 BIS 30. SEPTEMBER 1990]**
H.-L. Fichtner 1991 167 p In GERMAN; ENGLISH summary
(ISSN-0723-1903; ISSN-0722-0359; ETN-91-99831) Avail: Technische Univ., Universitaetsbibliothek und TIB, Welfengarten 1B, 3000 Hannover 1, Fed. Republic of Germany

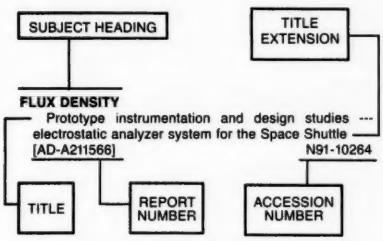
The research activities conducted from Oct. 1988 to Sep. 1990 in the framework of the 17 specialized fields of the university are reported. Five university institutes were working in cooperation with two other German universities on the development of a Computer Aided Design (CAD) machine for large monolithically integrated systems in silicon. A project was initiated on the development of a superlight alloy based on magnesium, lithium and hydrogen, which could be used in air and space travel structures, machine construction and robot technology. A number of projects dealt with environmental research. Six institutes are involved in the Hannover ecological research program, whose results are to be collated in a computerized environmental information system. ESA

**N91-33053#** Lawrence Livermore National Lab., CA.
**EARTH SCIENCES REPORT, 1989 - 1990**
L. W. Younker, ed., S. J. Peterson, ed., and M. E. Price, ed. Mar. 1991 189 p

(Contract W-7405-eng-48)
(DE91-017132; UCRL-LR-106135) Avail: NTIS HC/MF A09

The Earth Sciences Department at Lawrence Livermore National Laboratory (LLNL) conducts work in support of the Laboratory's energy, defense, environmental, and basic research programs. The Department comprises more than 100 professional scientific personnel spanning a variety of subdisciplines: geology, seismology, physics, geophysics, geochemistry, geohydrology, chemical engineering, and mechanical engineering. Resident technical support groups add significant additional technical expertise, including Containment Engineering, Computations, Electronic Engineering, Mechanical Engineering, Chemistry and Materials Science, and Technical Information. In total, approximately 180 professional scientists and engineers are housed in the Earth Sciences Department, making it one of the largest geoscience research groups in the nation. Previous Earth Sciences reports have presented an outline of the technical capabilities and accomplishments of the groups within the Department. In this FY 89/90 Report, we have chosen instead to present twelve of our projects in full-length technical articles. This Overview introduces those articles and highlights other significant research performed during this period. DOE

## Typical Subject Index Listing




The subject heading is a key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus*.

# A

**ABSORPTION**
Fluid handling 2: Surgical applications N91-32790
**ABSORPTION SPECTRA**
Photogenerated carrier-induced reactions on semiconductor surfaces
[DE91-017550] N91-32416
**ACCELERATED LIFE TESTS**
Direct influence of chip design and material composition on GaAs/GaAlAs laser diodes reliability N91-32307
A new approach to the reliability of electronic material systems N91-32310
Space qualification test and evaluation of JHU/APL designed ASICs N91-32315
Total dose study on LS-, ALS, and F-technology integrated circuits N91-32354
**ACCUMULATORS**
Nozzle diffuser for use with an open test section of a wind tunnel
[NASA-CASE-LAR-14424-1-SB] N91-32149
**ACOUSTIC PROPAGATION**
Near ground sound propagation in wind
[CSTB-2-89-003-4] N91-32871
**ACOUSTICS**
Acoustic damping of honeycomb-construction plates by pressure-sensitive adhesives
[NPL-DES-107] N91-32872
**ACTIVATION (BIOLOGY)**
Photobiological investigations on spores of Streptomyces griseus
[DLR-FB-91-14] N91-32748
**ACTIVE CONTROL**
Active control of vortex shedding frequency by a splitter plate N91-32059
Active damping using a control structure interaction approach N91-32290
**ACTIVITY (BIOLOGY)**
Photoinitiated electron transfer in multi-chromophoric species: Synthetic tetrads and pentads featuring diquinone moieties
[DE91-017413] N91-32896
**ACTUATORS**
Active damping using a control structure interaction approach N91-32290
A unified motion planning approach for redundant and nonredundant manipulators with actuator constraints N91-32494
Telerobot control system
[NASA-CASE-NPO-18116-1-CU] N91-32509
Linear mass actuator
[NASA-CASE-LAR-14352-1] N91-32511
Feedback controlled optics with wavefront compensation
[NASA-CASE-NPO-18194-1-CU] N91-32924
**ADA (PROGRAMMING LANGUAGE)**
Approved Ada uniformity issues
[NPL-DITC-172/91] N91-32809
The language compatible arithmetic standard and Ada
[NPL-DITC-173/91] N91-32810
Programming in a proposed 9X distributed Ada
[NASA-CR-188831] N91-32825
ART-Ada: An Ada-based expert system tool
[NASA-CR-188930] N91-32837
Ada issues in implementing ART-Ada
[NASA-CR-188941] N91-32838
Toward the efficient implementation of expert systems in Ada
[NASA-CR-188942] N91-32839
The comparison and selection of programming languages for high energy physics applications
[DE91-017130] N91-32910
**ADAPTIVE CONTROL**
Surface grid generation based on unstructured grid N91-32042
**ADAPTIVE OPTICS**
Interferometry N91-33022
**ADDITIVES**
The effect of chemical additives on the synthesis of ethanol
[DE91-016586] N91-32192
**ADDRESSING**
Recognition of simple visual images using a sparse distributed memory: Some implementations and experiments
[NASA-CR-186616] N91-32797
**ADHESION**
Lubrication with sputtered MoS2 films: Principles, operation, limitations
[NASA-TM-105292] N91-32216
**ADHESIVE BONDING**
Advanced thermoplastic resins, phase 2
[NASA-CR-187548] N91-32231
Adhesive bonding handbook for advanced structural materials
[ESA-PSS-03-210-ISSUE-1] N91-32234
**ADHESIVES**
Advanced thermoplastic resins, phase 2
[NASA-CR-187548] N91-32231
Adhesive bonding handbook for advanced structural materials
[ESA-PSS-03-210-ISSUE-1] N91-32234
Acoustic damping of honeycomb-construction plates by pressure-sensitive adhesives
[NPL-DES-107] N91-32872
**ADVECTION**
Hamiltonian chaos and transport in quasigeostrophic flows
[DE91-017385] N91-32464
**AERIAL RUDDERS**
Lightning protection of the Fokker 100 CFRP rudder N91-32612
**AERODYNAMIC CHARACTERISTICS**
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics
[NAL-SP-14] N91-32032
Analysis of the aerodynamic performance of counter-rotating propeller by means of vortex lattice method N91-32065
Aerodynamic computation post processing tools
[AAAF-NT-89-20] N91-32073
Determination of aerodynamic characteristics from ATTAS flight data gathering for ground-based simulator
[DLR-FB-91-15] N91-32076
Aerodynamics of combat aircraft controls and of ground effects
[AGARD-AR-271] N91-32082
**AERODYNAMIC FORCES**
Thermodynamic flow description of a ramjet for determination of engine forces and moments
[DLR-FB-91-02] N91-32139
**AERODYNAMIC INTERFERENCE**
Thin layer Navier-Stokes solutions for transonic multibody interference
[AD-A234252] N91-32072
**AERODYNAMIC LOADS**
Aeroelastic loads and stability investigation of a full-scale hingeless rotor
[NASA-TM-103867] N91-32134
**AERODYNAMIC STABILITY**
Aeroelastic loads and stability investigation of a full-scale hingeless rotor
[NASA-TM-103867] N91-32134
**AERODYNAMICS**
Finite difference numerical prediction of aerodynamics for airfoil flying over wavy wall N91-32043
Aerodynamic design of non-planar wing by inverse method with Navier-Stokes equation N91-32045
Aerodynamic computation post processing tools
[AAAF-NT-89-20] N91-32073
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441
**AEROELASTICITY**
Comparisons of elastic and rigid blade-element rotor models using parallel processing technology for piloted simulations
[NASA-TM-102859] N91-32071
Unstructured-grid methods development for unsteady aerodynamic and aeroelastic analyses
[NASA-TM-104143] N91-32084
Aeroelastic loads and stability investigation of a full-scale hingeless rotor
[NASA-TM-103867] N91-32134
**AERONAUTICAL ENGINEERING**
The role of computational fluid dynamics in aeronautical engineering (8): A mixed compression inlet for a supersonic airplane N91-32048
**AERONAUTICAL SATELLITES**
Satellite Communications (SATCOM) N91-32095
Aeronautical mobile satellite services ESA-PRODAT/SITA AIRCOM service trials programme N91-32106
Aeronautical Mobile Satellite Service (AMSS) message and voice access request transit delay N91-32107
Satellite data link research and development program in Japan N91-32108
**AEROSOLS**
International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects
[NASA-CP-3114] N91-32528
Science issues N91-32529
Measurements N91-32530
Laboratory and field studies of stratospheric aerosols: Phase changes under high supersaturation N91-32533
Validation of lidar and satellite remote sensing N91-32535
Lidar measurements at Garmisch, conversion model, and midlatitude aerosol effects N91-32536
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537
Aerosol sensing from balloons using photopolarimetry N91-32538
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539
A lidar equipped with photon counter for measuring stratospheric aerosols N91-32540
In situ measurements of light extinction of stratospheric aerosols N91-32541

Atmospheric aerosol and Doppler lidar studies N91-32666
NOAA backscatter studies N91-32679
Evaluation of aerosolized medications during parabolic flight maneuvers N91-32783

**AEROSPACE MEDICINE**
Publications and presentations of the Opthalmology Branch, USAF School of Aerospace Medicine, 1981-1990
[AD-A239458] N91-32754
Motion Sickness: Significance in Aerospace Operations and Prophylaxis
[AGARD-LS-175] N91-32759
Signs and symptoms of motion sickness and its basic nature N91-32760
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory N91-32761
Physical characteristics of stimuli provoking motion sickness N91-32762
Factors influencing susceptibility: Individual differences and human factors N91-32763
Simulator sickness N91-32765
Sea sickness N91-32766
Prevention and treatment of motion sickness: Non-pharmacological therapy N91-32767
Assessment of drug effectiveness N91-32768
Medical evaluations on the KC-135 1990 flight report summary
[NASA-TM-104740] N91-32776
Health maintenance facility: Dental equipment requirements N91-32777
Dental equipment test during zero-gravity flight N91-32778
Mini-rack testbed evaluation N91-32779
ATLS: Catheter and tube placement N91-32782
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals N91-32785
Minor surgery in microgravity N91-32786
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) N91-32787
Venipuncture and intravenous infusion access during zero-gravity flight N91-32788
Deployment and testing of a second prototype expandable surgical chamber in microgravity N91-32794

**AEROSPACE SAFETY**
Lightning current rate of rise in the new lightning flash model for the space shuttle program N91-32604

**AEROSPACE SCIENCES**
Scouting the neighborhood: In our lifetime
[DE91-017083] N91-32151
Collaboration technology and space science
[NASA-CR-188861] N91-32846

**AEROSPACE SYSTEMS**
The Telecommunications and Data Acquisition Report
[NASA-CR-188813] N91-32250
Bidirectional drive and brake mechanism
[NASA-CASE-MSC-21540-1] N91-32514
Coping with data from Space Station Freedom
[NASA-CR-188885] N91-33005

**AEROSPACE VEHICLES**
System requirements for low-Earth-orbit launch using laser propulsion
[DE91-017455] N91-32490
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1
[NASA-CP-3106-VOL-1] N91-32599

**AEROTHERMODYNAMICS**
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034

**AGING (MATERIALS)**
Direct influence of chip design and material composition on GaAs/GaAlAs laser diodes reliability N91-32307

**AGING (METALLURGY)**
A new approach to the reliability of electronic material systems N91-32310

**AIR**
Initial testing of a two-dimensional computer code for microwave-induced surface breakdown in air
[DE91-015763] N91-32286

**AIR BREATHING ENGINES**
Supersonic inlet flow computations with cavity N91-32049

**AIR CONDITIONING**
Site-specific investigations on aquifer thermal energy storage for space and process cooling
[DE91-017534] N91-32576

**AIR COOLING**
A comparison of the analytical and experimental performance of the solid version of a cooled radial turbine
[NASA-CR-187195] N91-32077

**AIR FLOW**
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida
[DE91-017445] N91-32743

**AIR LAND INTERACTIONS**
Turbulent energy exchange between atmosphere and surface layer. Methodology, measuring technical realizations, their limits, and possible uses
[ISBN-3-88148-263-6] N91-32596
Global water cycle N91-32661
Climate dynamics experiments using a GCM simulations N91-32663

**AIR NAVIGATION**
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
Automatic dependent surveillance Pacific engineering trials N91-32099
ADS (Automatic Dependent Surveillance) PET (Pacific Engineering Trial) program in Japan N91-32100

**AIR POLLUTION**
Sampling of atmospheric carbonyl compounds for determination by liquid chromatography after 2,4-dinitrophenylhydrazine labelling
[DE91-015842] N91-32585
Geoengineering the climate
[DE91-017654] N91-32589
Mexico City air quality research initiative: An overview and some statistical aspects
[DE91-018045] N91-32590
Climate research system
[DE91-016903] N91-32742
Assessing the risk of chronic lung injury attributable to long-term ozone exposure
[DE91-016814] N91-32757

**AIR QUALITY**
Mexico City air quality research initiative: An overview and some statistical aspects
[DE91-018045] N91-32590

**AIR SAMPLING**
Annular denuder systems: Precision and applicability to stratospheric sampling N91-32532

**AIR TRAFFIC CONTROL**
The First Annual International Satellite Surveillance and Communication Symposium
[DOT/FAA/RD-91/21] N91-32093
Automatic Dependent Surveillance (ADS) Program summary N91-32094
Satellite Communications (SATCOM) N91-32095
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
International Civil Aviation Organization (ICAO) Automatic Dependent Surveillance Panel (ADSP) activities N91-32097
International program summary N91-32098
Automatic dependent surveillance Pacific engineering trials N91-32099
ADS (Automatic Dependent Surveillance) PET (Pacific Engineering Trial) program in Japan N91-32100
Australian experiments in Automatic Dependent Surveillance (ADS) including the Pacific Engineering Trials (PET) N91-32101
French SATCOM program and related international activities N91-32102
Automatic Dependent Surveillance (ADS) development in Canada N91-32104
ADS communications: A cornerstone N91-32105
System improvements identified by the North Atlantic Systems Planning Group (NAT/SPG) as related to the capabilities of the Oceanic Display and Planning System (ODAPS) N91-32109
Operational SATCOM: Moving from trials to service N91-32111
The FAA/ARINC initial implementation of AMSS N91-32112
SITA satellite air communications implementation N91-32113
ADS integration into the flight management computer N91-32114
Use of ISO protocols in the ADS environment N91-32115
Near-term satellite-based oceanic air traffic control: Ground system description N91-32116
Impact of automation and data link enhancements on oceanic air traffic control N91-32117
US oceanic air traffic control: Past, present, and future N91-32118
Preliminary evaluation of ADS/radar correlation N91-32119
Cooperative ADS/AAS integration N91-32120
Operational oceanic air traffic control using satellite data link: Initial implementation N91-32121
Flight operations and air traffic management integration N91-32122
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
Satellite surveillance and communications airline benefits: The telephone myth N91-32124
Communications needs of the future air-ground interface N91-32125
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
Ground automation processing of near-term oceanic ATC data link messages N91-32127
Evaluation of oceanic flight deck workload and error reductions through the use of data communications N91-32128
Satellite data link validation test plan
[DOT/FAA/CT-TN91/6] N91-32282
Data Multiplexing Network (DMN), phase 3: Equipment Operational Test and Evaluation (OT&E)/Integration test plan
[DOT/FAA/CT-TN91/24] N91-32283

**AIR TRAFFIC CONTROLLERS (PERSONNEL)**
Study of the predictive validity of a psychological selection procedure for air-traffic controllers based on training criteria
[DLR-FB-91-11] N91-32090
Digitized voice trials N91-32103
Automatic Dependent Surveillance (ADS) development in Canada N91-32104
Near-term satellite-based oceanic air traffic control: Ground system description N91-32116

**AIR TRANSPORTATION**
The FAA/ARINC initial implementation of AMSS N91-32112

**AIR WATER INTERACTIONS**
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687

**AIRBORNE EQUIPMENT**
Uncertainty analysis of a radome flush orifice air motion system for the measurement of aircraft incident angles
[PB91-198176] N91-32133
Atmospheric aerosol and Doppler lidar studies N91-32666
Airborne CW lidar measurements of atmospheric backscatter at 9.1 and 10.6 microns N91-32677
On error sources during airborne measurements of the ambient electric field N91-32719

**AIRBORNE/SPACEBORNE COMPUTERS**
ESA Electronic Components Conference
[ESA-SP-313] N91-32291
Non volatile solid state magnetic memory technologies N91-32294
Radiation assessment of complex technologies N91-32342
Radiation assessment of the INMOS transputer family N91-32358

**AIRCRAFT ACCIDENT INVESTIGATION**
Analysis of rotorwash effects in helicopter mishaps
[DOT/FAA/RD-90/17] N91-32086
Aircraft accident report: Avianca, the Airline of Columbia, Boeing 707-321B, HK 2016, fuel exhaustion, Cove Neck, New York, January 25, 1990
[PB91-910404] N91-32087

**AIRCRAFT ACCIDENTS**
Aircraft accident report: Avianca, the Airline of Columbia, Boeing 707-321B, HK 2016, fuel exhaustion, Cove Neck, New York, January 25, 1990
[PB91-910404] N91-32087

**AIRCRAFT COMMUNICATION**
The First Annual International Satellite Surveillance and Communication Symposium
[DOT/FAA/RD-91/21] N91-32093
Automatic Dependent Surveillance (ADS) Program summary N91-32094
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
International Civil Aviation Organization (ICAO) Automatic Dependent Surveillance Panel (ADSP) activities N91-32097
International program summary N91-32098
Automatic dependent surveillance Pacific engineering trials N91-32099
ADS (Automatic Dependent Surveillance) PET (Pacific Engineering Trial) program in Japan N91-32100
Australian experiments in Automatic Dependent Surveillance (ADS) including the Pacific Engineering Trials (PET) N91-32101
System improvements identified by the North Atlantic Systems Planning Group (NAT/SPG) as related to the capabilities of the Oceanic Display and Planning System (ODAPS) N91-32109

**AIRCRAFT CONFIGURATIONS**
Navier-Stokes simulation for complete aircraft configuration N91-32046
On the maximum range of flying wings [AD-A229487] N91-32130
**AIRCRAFT CONSTRUCTION MATERIALS**
Modeling of electrically thick materials theoretical and experimental aspects N91-32605
Investigations into the damage for various types of unprotected carbon fibre composites with a variety of lightning arc attachments N91-32606
An assessment of tailoring of lightning protection design requirements for a composite wing structure on a metallic aircraft N91-32641
**AIRCRAFT CONTROL**
Aerodynamics of combat aircraft controls and of ground effects [AGARD-AR-271] N91-32082
Human-centered aircraft automation: A concept and guidelines [NASA-TM-103885] N91-32135
**AIRCRAFT DESIGN**
Aerodynamic design of non-planar wing by inverse method with Navier-Stokes equation N91-32045
Blended wing-body configuration design using transonic inverse code N91-32047
On the maximum range of flying wings [AD-A229487] N91-32130
Human-centered aircraft automation: A concept and guidelines [NASA-TM-103885] N91-32135
Aeroelastic flutter prevention in gliders and small aircraft [DLR-MITT-91-03] N91-32142
Application of an integrated flight/propulsion control design methodology to a STOVL aircraft [NASA-TM-105254] N91-32143
An assessment of tailoring of lightning protection design requirements for a composite wing structure on a metallic aircraft N91-32641
**AIRCRAFT ENGINES**
Design of lightning protection for a full-authority digital engine control N91-32717
Certification of lightning protection for a full-authority digital engine control N91-32718
**AIRCRAFT HAZARDS**
Analysis of rotorwash effects in helicopter mishaps [DOT/FAA/RD-90/17] N91-32086
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1 [NASA-CP-3106-VOL-1] N91-32599
Lightning threat to aircraft: Do we know all we need to know? N91-32600
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601
Intracloud development of lightning strikes to aircraft N91-32602
Current wave-form observed during lightning strikes on aircraft N91-32603
**AIRCRAFT INSTRUMENTS**
Electrical emissions of airplanes flying in electrified clouds and their effect on airplane measurements of cloud electric fields N91-32609
The performance of cable braids and terminations to lightning induced transients N91-32611
**AIRCRAFT MANEUVERS**
Development and evaluation of an inverse solution technique for studying helicopter maneuverability and agility [NASA-TM-102889] N91-32145
**AIRCRAFT MODELS**
Comparisons of elastic and rigid blade-element rotor models using parallel processing technology for piloted simulations [NASA-TM-102859] N91-32071
**AIRCRAFT NOISE**
Noise levels of USAF aircraft in exercise Luce Belle [NPL-RSA(EXT)-16] N91-32873
**AIRCRAFT PERFORMANCE**
Review of Air Force compressor blade and vane rework and it's impact on performance and costs [AD-A229518] N91-32136
Activation of the Navy's indirect effects lightning simulation laboratory N91-32628
**AIRCRAFT PILOTS**
Publications and presentations of the Opthalmology Branch, USAF School of Aerospace Medicine, 1981-1990 [AD-A239458] N91-32754
**AIRCRAFT RELIABILITY**
Certification of lightning protection for a full-authority digital engine control N91-32718
**AIRCRAFT SAFETY**
Aircraft accident report: Avianca, the Airline of Columbia, Boeing 707-321B, HK 2016, fuel exhaustion, Cove Neck, New York, January 25, 1990 [PB91-910404] N91-32087
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
Lightning protection of full authority digital electronic systems N91-32643
Observations of bi-directional leader development in a triggered lightning flash N91-32649
Application of surface electrical discharges to the study of lightning strikes on aircraft N91-32650
**AIRCRAFT STRUCTURES**
Modeling of electrically thick materials theoretical and experimental aspects N91-32605
Lightning protection of the Fokker 100 CFRP rudder N91-32612
Influence of configuration effects on multiple burst simulation testing N91-32631
**AIRCRAFT SURVIVABILITY**
Investigations into the damage for various types of unprotected carbon fibre composites with a variety of lightning arc attachments N91-32606
Lightning induced currents in aircraft wiring using low level injection techniques N91-32694
**AIRFOILS**
Finite difference numerical prediction of aerodynamics for airfoil flying over wavy wall N91-32043
Compressible flows with vortical disturbances around a cascade of airfoils N91-32083
**AIRFRAME MATERIALS**
Resistance of perished paints to Skydrol [INFORME-I-536/90] N91-32223
**AIRFRAMES**
Uncertainty analysis of a radome flush orifice air motion system for the measurement of aircraft incident angles [PB91-198176] N91-32133
The new Section 23 of DO160C/ED14C lightning testing of externally mounted electrical equipment N91-32716
**AIRLINE OPERATIONS**
Rotorcraft master plan [AD-A239444] N91-32081
Aircraft accident report: Avianca, the Airline of Columbia, Boeing 707-321B, HK 2016, fuel exhaustion, Cove Neck, New York, January 25, 1990 [PB91-910404] N91-32087
SITA satellite air communications implementation N91-32113
Use of ISO protocols in the ADS environment N91-32115
Evaluation of oceanic flight deck workload and error reductions through the use of data communications N91-32128
**AIRPORTS**
Rotorcraft master plan [AD-A239444] N91-32081
Synthetic aperture radar imagery of airports and surrounding areas: Study of clutter at grazing angles and their polarimetric properties [NASA-CR-4398] N91-32088
**AIRSPEED**
Uncertainty analysis of a radome flush orifice air motion system for the measurement of aircraft incident angles [PB91-198176] N91-32133
**ALCOHOLS**
High octane ethers from synthesis gas-derived alcohols [DE91-016596] N91-32193
**ALGORITHMS**
Numerical turbulent simulations of unsteady transonic cascade flows N91-32063
Time domain finite elements in optimal control with application to launch vehicle guidance N91-32156
Algorithms for structural natural-frequency design N91-32252
Carrier-to-noise power estimation for the Block 5 Receiver N91-32275
The development of solution algorithms for compressible flows N91-32423
A two-dimensional dynamic mix model in free Lagrange hydrodynamics [DE91-017661] N91-32467
Some stable reconstruction algorithms for electrical impedance tomography [DE91-016569] N91-32473
A reference model dynamics-CMAC algorithm for simulation and control of robotic manipulators N91-32507
Finite element implementation of state variable-based viscoplasticity models [NASA-CR-187212] N91-32523
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components [NASA-CR-187196] N91-32524
Lanczos eigensolution method for high-performance computers [NASA-TM-104108] N91-32526
Airborne observations of electric fields around growing and decaying cumulus clouds N91-32616
MAMS: High resolution atmospheric moisture/surface properties N91-32664
Interactive access and management for four-dimensional environmental data sets using McIDAS N91-32670
Research highlights: June 1990 - May 1991 N91-32676
WetNet: Using SSM/I data interactively for global distribution of rainfall and precipitable water N91-32685
The effect of the Earth's oblate spheroid shape on the accuracy of a time-of-arrival lightning ground strike locating system N91-32706
The Cortex Transform as an image preprocessor for sparse distributed memory: An initial study [NASA-CR-187436] N91-32798
On polynomial preconditioning for indefinite Hermitian matrices [NASA-CR-188857] N91-32814
Is thinking computable? [NASA-CR-188859] N91-32815
Evolutionary tree reconstruction [NASA-CR-188862] N91-32816
QMR: A Quasi-Minimal Residual method for non-Hermitian linear systems [NASA-CR-188882] N91-32818
An implementation of the look-ahead Lanczos algorithm for non-Hermitian matrices [NASA-CR-188889] N91-32820
Performance of a benchmark implementation of the Van Slyke and Wets algorithm for stochastic programs on the Alliant FX/8 [DE91-016515] N91-32833
G/SPLINES: A hybrid of Friedman's Multivariate Adaptive Regression Splines (MARS) algorithm with Holland's genetic algorithm [NASA-CR-188935] N91-32836
Learning-logic: Casting the cortex of the human brain in silicon [MIT-TR-47] N91-32840
Automatic blocking of nested loops [NASA-CR-188874] N91-32844
Multilevel filtering elliptic preconditioners [NASA-CR-188851] N91-32845
Highly parallel sparse Cholesky factorization [NASA-CR-188875] N91-32847
A biconjugate gradient type algorithm on massively parallel architectures [NASA-CR-188888] N91-32848
Parallel computing and domain decomposition [DE91-017967] N91-32854
Empirical results of a hybrid Monte Carlo method for the solution of Poisson's equation [DE91-016240] N91-32863
Macroscale implicit, electromagnetic particle simulation of inhomogeneous and magnetized plasmas in multi-dimensions [NIFS-91] N91-32929
**ALIGNMENT**
Three dimensional moire pattern alignment [NASA-CASE-MSC-21416-1] N91-32922
**ALIPHATIC COMPOUNDS**
Dynamics of charge-transfer excited states relevant to photochemical energy conversion [DE91-017710] N91-32578
**ALKALINE BATTERIES**
Oxygen electrodes for rechargeable alkaline fuel cells, 3 N91-32561
**ALLOYS**
The new metals and alloys compilation, a powerful materials analysis tool [DE91-016199] N91-32208
Development of polymer alloys for electrical engineering applications N91-33000
**ALTERNATING CURRENT**
I-BIEM calculations of the frequency dispersion and AC current distribution at disk and ring-disk electrodes N91-32559
**ALUMINUM**
Photon stimulated desorption from aluminum and stainless steel [DE91-017007] N91-32211
**ALUMINUM ALLOYS**
Effect of thermal exposure, forming, and welding on high-temperature, dispersion-strengthened aluminum alloy: Al-8Fe-1V-2Si [NASA-CR-187575] N91-32200

The role of anodic dissolution in the stress corrosion cracking of Al-Li-Cu alloy 2090
[DE91-016403] N91-32219
Damage to metallic samples produced by measured lightning currents N91-32640
Microstructural change and its influence on stress-strain behavior of two superplastic materials
[DE91-017431] N91-32980

**ALUMINUM ARSENIDES**
Processing issues and technologies for optoelectronics-integrated circuits and devices
[DE91-017451] N91-32406
Specular and diffuse scattering studies of multilayer interfaces
[DE91-016893] N91-32978

**ALUMINUM GALLIUM ARSENIDES**
Direct influence of chip design and material composition on GaAs/GaAlAs laser diodes reliability N91-32307

**ALUMINUM OXIDES**
Tensile and cyclic fatigue properties of SiC whisker-reinforced Al2O3
[DE91-015916] N91-32179
Reaction sintering of ZnO-Al2O3
[DE91-016254] N91-32210
Total dose effects in MOS systems: Influence of the initial hydrogen distribution N91-32338

**AMBIENT TEMPERATURE**
Advances in Li-TiS2 cell technology N91-32567

**AMORPHOUS MATERIALS**
Formation and annealing behavior of an amorphous layer induced by tin implantation into sapphire
[DE91-015929] N91-32960

**AMORPHOUS SILICON**
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium
[DE91-016161] N91-32964

**AMPLIFICATION**
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs)
[DE91-016196] N91-32407
Small signal gain for parabolic profile beams in free electron lasers
[DE91-016236] N91-32478

**ANALOG CIRCUITS**
Optimization of CMOS technology and design for deep cryogenic analog circuits N91-32296
Analog CMOS/SOS in radiative environments N91-32350
Analog hardware for learning neural networks
[NASA-CASE-NPO-17664-1-CU] N91-32852

**ANALOG TO DIGITAL CONVERTERS**
Design and status of the RF-digitizer integrated circuit N91-32262
An 8 bit high performance ADC in silicon on sapphire N91-32302
Analog-to-digital conversion techniques
[AD-A239469] N91-32796

**ANALOGS**
Human analogue models for computer-aided design and engineering applications
[AD-A229520] N91-32775

**ANALYSIS (MATHEMATICS)**
Scale-model charge-transfer technique for measuring enhancement factors N91-32651
Hamiltonians and Lagrangians for one-dimensional autonomous systems and dissipative systems
[DE91-017595] N91-32868

**ANALYTICAL CHEMISTRY**
Analysis of samples for the second (1990) round robin interlaboratory exercise
[FFI-91/6004] N91-32188

**ANALYZERS**
Annular denuder systems: Precision and applicability to stratospheric sampling N91-32532

**ANGLES (GEOMETRY)**
Uncertainty analysis of a radome flush orifice air motion system for the measurement of aircraft incident angles
[PB91-198176] N91-32133

**ANHYDRIDES**
Addition polyimides with enhanced processability
[NASA-CASE-LEW-15043-1] N91-32230

**ANIMALS**
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770

**ANIMATION**
Several issues of visualization techniques in computational fluid dynamics 2 N91-32044

**ANISOTROPY**
Displacement threshold energy in GaAs determined by electrical and optical investigations N91-32337
A study of fracture mechanisms in ATD roller bearing
[NASA-CR-184200] N91-32497
Method for anisotropic etching in the manufacture of semiconductor devices
[NASA-CASE-MSC-21631-1] N91-32947
Anisotropy in the a-b plane of normal and superconducting YBa2Cu3O(x)
[DE91-017997] N91-32989

**ANNEALING**
Total dose effects on Charge Coupled Devices (CCD) reverse annealing phenomena N91-32341
Neutron, gamma ray and post-irradiation thermal annealing effects on power semiconductor switches
[NASA-TM-105248] N91-32410
Formation and annealing behavior $c^4$ an amorphous layer induced by tin implantation into sapphire
[DE91-015929] N91-32960

**ANODES**
The role of anodic dissolution in the stress corrosion cracking of Al-Li-Cu alloy 2090
[DE91-016403] N91-32219

**ANTARCTIC REGIONS**
Measurements in polar stratospheric clouds over Antarctica in September 1989 N91-32534
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537

**ANTENNA ARRAYS**
Algorithms for structural natural-frequency design N91-32252
Channel assignments and array gain bounds for the Ka-band array feed compensation system N91-32263
A carrier-arraying demonstration at Goldstone for receiving Pioneer 11 signals N91-32273

**ANTENNA COMPONENTS**
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253

**ANTENNA DESIGN**
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
Modeling and simulations of the DSS 13 antenna control system N91-32268
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 2: Tests on the antenna N91-32270

**ANTENNA FEEDS**
Channel assignments and array gain bounds for the Ka-band array feed compensation system N91-32263

**ANTENNAS**
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
Wideband microwave generation with GaAs photoconductive switches
[DE91-017544] N91-32415

**ANTHROPOMETRY**
Human analogue models for computer-aided design and engineering applications
[AD-A229520] N91-32775

**ANTICYCLONES**
Synoptic/planetary-scale interactions and blocking over the North Atlantic Ocean N91-32692

**ANTIMATTER**
EXAM: A search for extragalactic antimatter N91-33035

**ANTISUBMARINE WARFARE AIRCRAFT**
Results of the recent precipitation static flight test program on the Navy P-3B antisubmarine aircraft N91-32626

**ANVILS**
High pressure Moessbauer spectroscopy in diamond anvil cells
[DE91-016018] N91-32961

**APPLICATION SPECIFIC INTEGRATED CIRCUITS**
CNES activities on ASIC N91-32298
Design and manufacture of space ASICs today and tomorrow: Promises and problems N91-32299
Digital ASIC design for space applications N91-32300
Space qualification test and evaluation of JHU/APL designed ASICs N91-32315
Test chips and ASIC qualification N91-32327
Effects of design on total dose characteristics of ASIC technologies N91-32333
Calibration of ASIC library for radiation tolerant space applications methodology and experiment N91-32334
Analog CMOS/SOS in radiative environments N91-32350
Evaluation of FPGAs N91-32361
ABB Hafo's ESA approved capability domain for CMOS/SOS ASICs N91-32388

**APPLICATIONS PROGRAMS (COMPUTERS)**
CLINEWS: NOAA Western Region computer programs and problems
[PB91-200709] N91-32831
Gigaflop performance on a CRAY-2: Multitasking a computational fluid dynamics application
[NASA-TM-4305] N91-32841

**APPROXIMATION**
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441
Mathematical models for determining the protected spaces of the vertical lightning rod N91-32634
Analog-to-digital conversion techniques
[AD-A239469] N91-32796

**AQUIFERS**
Site-specific investigations on aquifer thermal energy storage for space and process cooling
[DE91-017534] N91-32576

**ARC DISCHARGES**
Investigations into the damage for various types of unprotected carbon fibre composites with a variety of lightning arc attachments N91-32606

**ARC WELDING**
High speed welding used in building metallic structures
[CRIF-MT-180] N91-32496

**ARCHITECTURE (COMPUTERS)**
Cooperative ADS/AAS integration N91-32120
Highly parallel computer architecture for robotic computation
[NASA-CASE-NPO-17632-1-CU] N91-32805
Analog hardware for learning neural networks
[NASA-CASE-NPO-17664-1-CU] N91-32852
Present and future supercomputer network architectures
[DE91-018035] N91-32855
What's happening with supercomputer networks?
[DE91-018036] N91-32856

**ARCTIC OCEAN**
Naval arctic manual, ATP 17(A)
[PB91-193920] N91-32584

**ARCTIC REGIONS**
Aerosol sensing from balloons using photopolarimetry N91-32538

**ARGON ISOTOPES**
Helium isotopic constraints on terrestrial degassing and the transcrustal transport of mantle methane
[PB91-206458] N91-32594

**ARM (ANATOMY)**
Rotationally actuated prosthetic helping hand
[NASA-CASE-MFS-28426-1] N91-32795

**ARRAYS**
Evaluation of FPGAs N91-32361

**ARTIFICIAL INTELLIGENCE**
Application of AI to engineering problems N91-32033
Predicting cloud-to-ground lightning with neural networks N91-32646
Is thinking computable?
[NASA-CR-188859] N91-32815
User documentation for the MSK and OMS intelligent tutoring systems
[NASA-CR-188815] N91-32823
Research into the interaction between high performance and cognitive skills in an intelligent tutoring system
[NASA-CR-188821] N91-32830
Learning-logic: Casting the cortex of the human brain in silicon
[MIT-TR-47] N91-32840
Equations of learning and capacity of layered neural networks
[AD-A229633] N91-32857

**ASBESTOS**
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770

**ASSEMBLING**
High performance packages for space applications: Review of packaging and assembly methods for long wavelength laser diodes N91-32318
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325

**ASTRONAUTS**
Publications and presentations of the Opthalmology Branch, USAF School of Aerospace Medicine, 1981-1990
[AD-A239458] N91-32754

**ASTRONOMICAL CATALOGS**
JPL 1990-3: A 5-nrad extragalactic source catalog based on combined radio interferometric observations N91-32276

**ASTRONOMICAL MODELS**
Testing the big bang: Light elements, neutrinos, dark matter, and large-scale structure
[DE91-017379] N91-33040
Asymmetries in extragalactic radio sources N91-33050

**ASTRONOMICAL OBSERVATORIES**
Status of the profession N91-33031

**ASTRONOMY**
The decade of discovery in astronomy and astrophysics
[NASA-CR-188226] N91-33016
Working Papers: Astronomy and Astrophysics Panel Reports
[NASA-CR-188785] N91-33017
Optical/IR from ground N91-33020
Planetary astronomy N91-33027
Policy opportunities N91-33029
Benefits to the nation from astronomy and astrophysics N91-33030
Status of the profession N91-33031
**ASTROPHYSICS**
Further proton damage effects in EEV CCDs N91-32340
The decade of discovery in astronomy and astrophysics
[NASA-CR-188226] N91-33016
Working Papers: Astronomy and Astrophysics Panel Reports
[NASA-CR-188785] N91-33017
Infrared astronomy N91-33019
High energy from space N91-33023
Particle astrophysics N91-33024
Theory and laboratory astrophysics N91-33025
Computing and data processing N91-33028
Policy opportunities N91-33029
Benefits to the nation from astronomy and astrophysics N91-33030
Astrophysical neutron capture processes
[DE91-017071] N91-33039
Particle theory and cosmology
[DE91-017730] N91-33041
Asymmetries in extragalactic radio sources N91-33050
**ASYMMETRY**
Asymmetries in extragalactic radio sources N91-33050
**ASYMPTOTIC METHODS**
A k-epsilon modeling of near wall turbulence
[NASA-TM-105238] N91-32460
Finite element implementation of state variable-based viscoplasticity models
[NASA-CR-187212] N91-32523
**ASYMPTOTIC PROPERTIES**
Determining finite volume elements for the 2D Navier-Stokes equations
[DE91-016028] N91-32452
**ASYMPTOTIC SERIES**
Resonant triad in boundary-layer stability. Part 2: Composite solution and comparison with observations
[NASA-TM-105209] N91-32459
Small signal gain for parabolic profile beams in free electron lasers
[DE91-016236] N91-32478
**ATLANTIC OCEAN**
Synoptic/planetary-scale interactions and blocking over the North Atlantic Ocean N91-32692
**ATMOSPHERIC CHEMISTRY**
Proceedings of 2nd US/FRG Workshop on Photochemical Ozone Problem and its Control
[PB91-211847] N91-32583
Sampling of atmospheric carbonyl compounds for determination by liquid chromatography after 2,4-dinitrophenylhydrazine labelling
[DE91-015842] N91-32585
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588
Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere N91-32673
**ATMOSPHERIC CIRCULATION**
On the nonlinear response of minor atmospheric species to linear gravity waves N91-32593
Research on diabatic initialization N91-32671
Potential vorticity index N91-32672
Nonlinear feedbacks between stratocumulus and synoptic-scale systems N91-32674
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686
South Pacific convergence zone and global scale circulations (Jul. 1987 - Jul. 1991). Observational and modeling studies of heat, moisture, precipitation, and global-scale circulation patterns (Jul. 1990 - Jul. 1993) N91-32691
Synoptic/planetary-scale interactions and blocking over the North Atlantic Ocean N91-32692
Precipitation regime changes associated with climatic changes
[PB91-206656] N91-32740
Climate research system
[DE91-016903] N91-32742
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida
[DE91-017445] N91-32743
**ATMOSPHERIC COMPOSITION**
Ionization of NO at high temperature
[NASA-CR-188798] N91-32187
Annular denuders for use in global climate and stratospheric measurements of acidic gases and particles N91-32531
Annular denuder systems: Precision and applicability to stratospheric sampling N91-32532
Validation of lidar and satellite remote sensing N91-32535
A lidar equipped with photon counter for measuring stratospheric aerosols N91-32540
Geoengineering the climate
[DE91-017654] N91-32589
On the nonlinear response of minor atmospheric species to linear gravity waves N91-32593
**ATMOSPHERIC EFFECTS**
Interferometry N91-33022
**ATMOSPHERIC ELECTRICITY**
Intracloud development of lightning strikes to aircraft N91-32602
Current wave-form observed during lightning strikes on aircraft N91-32603
Electrical emissions of airplanes flying in electrified clouds and their effect on airplane measurements of cloud electric fields N91-32609
E and DE/DT waveshapes for narrow bipolar pulses in intracloud lightning N91-32610
Predicting cloud-to-ground lightning with neural networks N91-32646
Electrification in winter storms and the analysis of thunderstorm overflight N91-32678
On error sources during airborne measurements of the ambient electric field N91-32719
A study of point discharge current observations in the thunderstorm environment at a tropical station during the year 1987 and 1988 N91-32721
**ATMOSPHERIC GENERAL CIRCULATION MODELS**
Climate dynamics experiments using a GCM simulations N91-32663
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687
Parallel scalability of the spectral transform method
[DE91-017991] N91-32744
**ATMOSPHERIC HEATING**
Research on diabatic initialization N91-32671
**ATMOSPHERIC MODELS**
Parallelizing the spectral transform method, part 2
[DE91-017131] N91-32456
Validation of lidar and satellite remote sensing N91-32535
Proceedings of 2nd US/FRG Workshop on Photochemical Ozone Problem and its Control
[PB91-211847] N91-32583
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
A study of the magnetosphere-ionosphere coupling processes N91-32595
Global water cycle N91-32661
AMPR/SSMI data comparisons N91-32665
Nonlinear feedbacks between stratocumulus and synoptic-scale systems N91-32674
Laboratory and theoretical models of planetary-scale instabilities and waves N91-32675
Research highlights: June 1990 - May 1991 N91-32676
NOAA backscatter studies N91-32679
Beta measurements N91-32681
Monitoring, analyzing, and modeling global climate N91-32689
Climate research system
[DE91-016903] N91-32742
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida
[DE91-017445] N91-32743
Additions to Mars Global Reference Atmospheric Model (Mars-GRAM)
[NASA-CR-188924] N91-33045
**ATMOSPHERIC MOISTURE**
Global water cycle N91-32661
MAMS: High resolution atmospheric moisture/surface properties N91-32664
Research on diabatic initialization N91-32671
Remote sensing of water vapor features N91-32682
**ATMOSPHERIC PHYSICS**
NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review
[NASA-CP-3126] N91-32660
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687
**ATMOSPHERIC RADIATION**
High resolution measurements of density structures in the Jovian plasma sheet
[NASA-CR-188918] N91-33043
**ATMOSPHERIC SCATTERING**
Atmospheric aerosol and Doppler lidar studies N91-32666
Airborne CW lidar measurements of atmospheric backscatter at 9.1 and 10.6 microns N91-32677
**ATMOSPHERIC SOUNDING**
The physics and instrumentation of passive atmospheric sounding: A review of the methods of remote sensing of temperature and moisture in the Earth's lower atmosphere
[ESA-STR-231] N91-32597
Remote sensing of water vapor features N91-32682
WetNet: Using SSM/I data interactively for global distribution of rainfall and precipitable water N91-32685
**ATMOSPHERIC TEMPERATURE**
Global water cycle N91-32661
Climate dynamics experiments using a GCM simulations N91-32663
Global temperature variations N91-32683
Monitoring, analyzing, and modeling global climate N91-32689
Tropical Pacific moisture variability N91-32690
**ATMOSPHERIC TIDES**
Additions to Mars Global Reference Atmospheric Model (Mars-GRAM)
[NASA-CR-188924] N91-33045
**ATMOSPHERIC TURBULENCE**
Propagation limitations for transionospheric systems from 10 to 300 GHz N91-32243
Turbulent energy exchange between atmosphere and surface layer. Methodology, measuring technical realizations, their limits, and possible uses
[ISBN-3-88148-263-6] N91-32596
Indirect imaging through the atmosphere
[ESA-TT-1115] N91-33034
**ATOMIC COLLISIONS**
Ultrarelativistic atomic collisions
[DE91-016768] N91-32884
Atomic and molecular collision processes
[DE91-017649] N91-32897
Computer simulation studies of high energy collision cascades
[DE91-016225] N91-32903
**ATOMIC STRUCTURE**
The role of spin chemistry in the primary events of photosynthesis
[DE91-017301] N91-32752
Atomic and molecular collision processes
[DE91-017649] N91-32897
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium
[DE91-016161] N91-32964
**ATOMIZING**
Development of a spray-forming process for steel
[DE91-015812] N91-32218
**ATTACK AIRCRAFT**
Aerodynamics of combat aircraft controls and of ground effects
[AGARD-AR-271] N91-32082
Activation of the Navy's indirect effects lightning simulation laboratory N91-32628
**ATTENUATION**
Radiation-induced attenuation of high-OH optical fibers after hydrogen treatment in the presence of ionizing radiation
[DE91-016093] N91-32921
**ATTENUATION COEFFICIENTS**
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539
In situ measurements of light extinction of stratospheric aerosols N91-32541
**AUTOCORRELATION**
Mode-stirred chamber field statistics: Correlation widths
[DE91-016190] N91-32289
**AUTOMATIC CONTROL**
Automatic Dependent Surveillance (ADS) Program summary N91-32094
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
International Civil Aviation Organization (ICAO) Automatic Dependent Surveillance Panel (ADSP) activities N91-32097
Automatic dependent surveillance Pacific engineering trials N91-32099
Australian experiments in Automatic Dependent Surveillance (ADS) including the Pacific Engineering Trials (PET) N91-32101
Automatic Dependent Surveillance (ADS) development in Canada N91-32104

Near-term satellite-based oceanic air traffic control: Ground system description N91-32116
Impact of automation and data link enhancements on oceanic air traffic control N91-32117
Cooperative ADS/AAS integration N91-32120
Human-centered aircraft automation: A concept and guidelines
[NASA-TM-103885] N91-32135
IDEF3 and IDEF4 automation system requirements document and system environment models
[NASA-CR-188829] N91-32804
From an automated flight-test management system to a flight-test engineer's workstation
[NASA-TM-104242] N91-32851

**AUTOMATIC PILOTS**
A NASA/RAE cooperation in the development of a real-time knowledge-based autopilot
[NASA-TM-104234] N91-32850

**AUTOMATIC WEATHER STATIONS**
Methods for the automatic de-aliasing of the Doppler velocity of a weather radar
[DLR-FB-91-08] N91-32249

**AUTOMOBILE ACCIDENTS**
Vehicle Animation Software (VAS) to animate results obtained from vehicle handling and rollover simulations and tests
[PB91-194142] N91-32832

**AUTONOMY**
Infrastructure for thulium-170 isotope power systems for autonomous underwater vehicle fleets
[DE91-017464] N91-32911

**AVALANCHE DIODES**
Design and testing of an active quenching circuit for an avalanche photodiode photon detector N91-32258
Performance evaluation of new large-area avalanche photodiodes for scintillation spectroscopy
[DE91-017400] N91-32405

**AVIATION METEOROLOGY**
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1
[NASA-CP-3106-VOL-1] N91-32599
VHF discharges in storm cells producing microbursts N91-32620
Observations of bi-directional leader development in a triggered lightning flash N91-32649

**AVIONICS**
ADS integration into the flight management computer N91-32114
Satellite data link validation test plan
[DOT/FAA/CT-TN91/6] N91-32282

**AXISYMMETRIC FLOW**
An experimental study of natural and forced modes in an axisymmetric jet
[NASA-TM-105225] N91-32074
Basic studies of baroclinic flows N91-32662

**AZEOTROPES**
Advantages of enthalpy-temperature diagrams for nonazeotropic refrigerant mixtures
[DE91-016774] N91-32991

**AZINES**
Photoinitiated electron transfer in multi-chromophoric species: Synthetic tetrads and pentads featuring diquinone moieties
[DE91-017413] N91-32896

## B

**BACKGROUND RADIATION**
Spectral filters for laser communications N91-32257

**BACKSCATTERING**
Observations of Enhanced Radar Backscatter (ERB) from Millstone Hill
[NASA-CR-188877] N91-32280
Lidar measurements at Garmisch, conversion model, and midlatitude aerosol effects N91-32536
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537
Atmospheric aerosol and Doppler lidar studies N91-32666
Airborne CW lidar measurements of atmospheric backscatter at 9.1 and 10.6 microns N91-32677
NOAA backscatter studies N91-32679
Ion implantation effects in crystalline quartz
[DE91-016192] N91-32977

**BACKWARD FACING STEPS**
Numerical calculation of flow for scramjet engine N91-32035

**BALL LIGHTNING**
How to create ball lightning N91-32728

**BALLOON-BORNE INSTRUMENTS**
Lidar measurements at Garmisch, conversion model, and midlatitude aerosol effects N91-32536

**BALLOONING MODES**
An H-mode-like bifurcation in core plasma of stellarators
[NIFS-97] N91-32933

**BALLOONS**
Aerosol sensing from balloons using photopolarimetry N91-32538

**BAND STRUCTURE OF SOLIDS**
Electron energies in metals
[DE91-016759] N91-32214

**BANDWIDTH**
A carrier-arraying demonstration at Goldstone for receiving Pioneer 11 signals N91-32273

**BARIUM OXIDES**
De Haas van Alphen effect in high temperature superconductors
[DE91-016198] N91-32397
Neutron diffraction by the flux lattice in high-Tc superconductors
[DE91-017866] N91-32418
Neutron scattering from the flux lattice in high temperature superconductors
[DE91-017947] N91-32419
Critical currents in melt-textured YBa2Cu3O(x)
[DE91-016523] N91-32966
Evidence for cation disorder in in-situ grown YBaCuO superconducting films
[DE91-016760] N91-32971
Magnetic relaxation in a single crystal of YBa2Cu3O(x)
[DE91-017963] N91-32986

**BAROCLINIC INSTABILITY**
Research highlights: June 1990 - May 1991 N91-32676

**BAROCLINIC WAVES**
Basic studies of baroclinic flows N91-32662

**BAROCLINITY**
Basic studies of baroclinic flows N91-32662

**BARYONS**
Baryon inhomogeneity from the cosmic quark-hadron phase transition
[DE91-016608] N91-33051

**BATTERY CHARGERS**
Modeling and analysis of spacecraft battery charger systems N91-32411

**BEAM CURRENTS**
Emittance variations in current-amplifying ion induction linacs
[DE91-016266] N91-32909
Beam-driven currents in the 1/nu regime in a helical system
[NIFS-27] N91-32955

**BEAM INJECTION**
The Los Alamos photoinjector-driven free-electron laser
[DE91-017824] N91-32492
Simulation of APLE photoinjector
[DE91-018048] N91-32493
SEPAC data analysis in support of the environmental interaction program
[NASA-CR-184201] N91-32579
A pulsed lepton source at LAMPF
[DE91-016010] N91-32904
Kinetic theory of RF current drive and helicity injection
[DE91-017388] N91-32946
Beam-driven currents in the 1/nu regime in a helical system
[NIFS-27] N91-32955

**BEAM SWITCHING**
Beam optics of the AmPS extraction line
[NIKHEF-K/AMPS/91-01] N91-32914

**BEAM WAVEGUIDES**
Initial pointing calibrations for the DSS 13 34-meter beam-waveguide antenna N91-32267
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 1: Design and ground tests N91-32269
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 2: Tests on the antenna N91-32270
Efficiency calibration of the DSS 13 34-meter diameter beam waveguide antenna at 8.45 and 32 GHz N91-32271
DSS 13 phase 2 pedestal room microwave layout N91-32272
Wideband waveguide polarizer development for SETI N91-32277

**BEAMS (RADIATION)**
Beam optics of the AmPS extraction line
[NIKHEF-K/AMPS/91-01] N91-32914

**BEAMS (SUPPORTS)**
High speed welding used in building metallic structures
[CRIF-MT-180] N91-32496
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525

**BEARINGS**
Evaluation of the damages caused by lightning current flowing through bearings N91-32632

**BENARD CELLS**
Numerical simulation of turbulent convection over wavy surfaces
[DLR-FB-91-12] N91-32439

**BEND TESTS**
Load-line displacements for three-point bend J tests using bottom surface displacements
[AD-A229634] N91-32518

**BENDING**
A simple sagittal focusing crystal which utilizes a bimetallic strip
[DE91-017324] N91-32975

**BETA FACTOR**
Axial pressure profile effects on flute interchange stability in the tandem mirror GAMMA 10
[NIFS-98] N91-32934

**BIAS**
Carrier-to-noise power estimation for the Block 5 Receiver N91-32275

**BIBLIOGRAPHIES**
Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography
[PB91-173351] N91-32755

**BIG BANG COSMOLOGY**
Testing the big bang: Light elements, neutrinos, dark matter, and large-scale structure
[DE91-017379] N91-33040

**BIMETALS**
Theoretical modelling of AFM for bimetallic tip-substrate interactions
[NASA-TM-105280] N91-32215
A simple sagittal focusing crystal which utilizes a bimetallic strip
[DE91-017324] N91-32975

**BINARY ALLOYS**
A new approximate sum rule for bulk alloy properties
[NASA-TM-105282] N91-32204
Theoretical modelling of AFM for bimetallic tip-substrate interactions
[NASA-TM-105280] N91-32215
Ordering energy of B2 alloys calculated in the frozen potential and Harris approximations
[DE91-017228] N91-32220

**BINARY FLUIDS**
Reciprocity theory of binary inelastic encounters
[IC-AERO-89-03] N91-32425

**BINARY STARS**
Coalescing binary systems of compact objects to (post) sup 5/2 Newtonian order: Late-time evolution and gravitational radiation emission N91-33037

**BIOASSAY**
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770

**BIOASTRONAUTICS**
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals N91-32785
Minor surgery in microgravity N91-32786
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) N91-32787
Venipuncture and intravenous infusion access during zero-gravity flight N91-32788

**BIODYNAMICS**
Some stable reconstruction algorithms for electrical impedance tomography
[DE91-016569] N91-32473
Rotationally actuated prosthetic helping hand
[NASA-CASE-MFS-28426-1] N91-32795

**BIOLOGICAL EFFECTS**
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
Biophysical and biomathematical adventures in radiobiology
[DE91-017484] N91-32750
Interaction of extremely-low-frequency electromagnetic fields with humans
[DE91-015779] N91-32756
Simulator sickness N91-32765
Circular Intensity Differential Scattering (CIDS) measurements in the soft x ray region of the spectrum (approximately 16 eV to 500 eV)
[DE91-016429] N91-32915

**BIOLOGICAL MODELS (MATHEMATICS)**
Biophysical and biomathematical adventures in radiobiology
[DE91-017484] N91-32750

**BIOPHYSICS**
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root
[DE91-016255] N91-32749

Biophysical and biomathematical adventures in radiobiology
[DE91-017484] N91-32750
**BIOPOLYMERS**
Krupp Technical Reports, number 2, December 1990 (English version)
[ISSN-0930-9276] N91-32994
Manufacture of containers from an oriented biopolymer N91-32999
**BIOPROCESSING**
Manufacture of containers from an oriented biopolymer N91-32999
**BIPOLAR TRANSISTORS**
Reliability of microwave bipolar silicon transistors N91-32305
Bipolar microwave transistor technology N91-32324
An approximate HSPICE model for orbit low noise analog bipolar NPN transistors
[DE91-017220] N91-32414
**BIPOLARITY**
Total dose study on LS-, ALS, and F-technology integrated circuits N91-32354
E and DE/DT waveshapes for narrow bipolar pulses in intracloud lightning N91-32610
**BISMUTH**
Liquid and solid Ga and Bi studies with a variable energy positron beam
[DE91-016910] N91-32889
**BIT ERROR RATE**
Coding gains and error rates from the Big Viterbi Decoder N91-32264
**BLADE TIPS**
Analysis of the aerodynamic performance of counter-rotating propeller by means of vortex lattice method N91-32065
Navier-Stokes analysis for flowfield around hovering rotor N91-32066
**BLANKETS (FUSION REACTORS)**
The evolution of US helium-cooled blankets
[DE91-017938] N91-32952
**BLOCKING**
Synoptic/planetary-scale interactions and blocking over the North Atlantic Ocean N91-32692
Automatic blocking of nested loops
[NASA-CR-188874] N91-32844
**BLOOD**
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
**BLOOD FLOW**
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
Fluid handling 2: Surgical applications N91-32790
**BLUNT BODIES**
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441
**BODY-WING CONFIGURATIONS**
Blended wing-body configuration design using transonic inverse code N91-32047
**BORN APPROXIMATION**
Specular and diffuse scattering studies of multilayer interfaces
[DE91-016893] N91-32978
**BOUNDARY CONDITIONS**
Compressible flows with vortical disturbances around a cascade of airfoils N91-32083
Time domain finite elements in optimal control with application to launch vehicle guidance N91-32156
Numerical study of partitioned turbulence
[ONERA-RSF-20/3419-AY-124A] N91-32437
Modeling of electrically thick materials theoretical and experimental aspects N91-32605
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687
**BOUNDARY INTEGRAL METHOD**
I-BIEM calculations of the frequency dispersion and AC current distribution at disk and ring-disk electrodes N91-32559
**BOUNDARY LAYER COMBUSTION**
Catalytic combustion of methane
[PB91-206391] N91-32190
**BOUNDARY LAYER FLOW**
A laser velocimeter investigation of the normal shock-wave boundary layer interaction
[NASA-TM-105201] N91-32440
Calculation of turbulent compressible flows N91-32445
Some current approaches in turbulence modelling N91-32446
Turbulence models for natural convection flows along a vertical heated plane N91-32447
Turbulent flow modelling in Spain: Overview and developments N91-32448
Computational turbulence studies in Turkey N91-32449
Surface wind convergence as a short-term predictor of cloud-to-ground lightning at Kennedy Space Center: A four-year summary and evaluation N91-32703
**BOUNDARY LAYER SEPARATION**
Aerodynamic design of non-planar wing by inverse method with Navier-Stokes equation N91-32045
Unsteady flow analysis in two-dimensional compressor cascade N91-32064
**BOUNDARY LAYER STABILITY**
Resonant triad in boundary-layer stability. Part 1: Fully nonlinear interaction
[NASA-TM-105208] N91-32458
Resonant triad in boundary-layer stability. Part 2: Composite solution and comparison with observations
[NASA-TM-105209] N91-32459
**BOUNDARY LAYER TRANSITION**
Resonant triad in boundary-layer stability. Part 1: Fully nonlinear interaction
[NASA-TM-105208] N91-32458
Resonant triad in boundary-layer stability. Part 2: Composite solution and comparison with observations
[NASA-TM-105209] N91-32459
**BOUNDARY LAYERS**
An experimental study of natural and forced modes in an axisymmetric jet
[NASA-TM-105225] N91-32074
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441
An approximate Riemann solver for hypervelocity flows
[NASA-CR-187629] N91-32463
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688
**BOUNDARY VALUE PROBLEMS**
Compressible flows with vortical disturbances around a cascade of airfoils N91-32083
Optimal control problems with switching points
[NASA-CR-4393] N91-32155
Computational Fluid Dynamics
[VKI-LS-1991-01] N91-32426
Determining finite volume elements for the 2D Navier-Stokes equations
[DE91-016028] N91-32452
Small signal gain for parabolic profile beams in free electron lasers
[DE91-016236] N91-32478
**BRAIN**
Learning-logic: Casting the cortex of the human brain in silicon
[MIT-TR-47] N91-32840
**BRAKES (FOR ARRESTING MOTION)**
Bidirectional drive and brake mechanism
[NASA-CASE-MSC-21540-1] N91-32514
**BRAZING**
Fundamental metallurgical considerations in brazing and soldering
[DE91-016224] N91-32209
Graphite-metal brazing for thermal applications
[DE91-016647] N91-32944
**BRIGHTNESS TEMPERATURE**
Global temperature variations N91-32683
Deriving Earth science products from SSM/I N91-32684
Monitoring, analyzing, and modeling global climate N91-32689
**BRITTLE MATERIALS**
Analytical and numerical studies of fracture and fatigue in ceramic materials N91-32516
**BROADBAND**
Wide band systems N91-32242
Propagation limitations for transionospheric systems from 10 to 300 GHz N91-32243
HF systems operating beneath the ionosphere N91-32244
Wideband waveguide polarizer development for SETI N91-32277
Wideband HF noise/interference modeling, part 1. First-order statistics. Technical memorandum series
[PB91-208454] N91-32281
**BROMINE**
Effect of lightning strike on bromine intercalated graphite fiber/epoxy composites
[NASA-TM-104507] N91-32177
**BUBBLES**
Numerical analysis of bubbly liquid in convergent-divergent nozzle N91-32052
**BUCKLING**
Failure mechanisms and prediction in advanced composite materials N91-32184
**BUDGETING**
Working Papers: Astronomy and Astrophysics Panel Reports
[NASA-CR-188785] N91-33017
**BUILDINGS**
Evaluating lightning hazards to building environments using explicit numerical solutions of Maxwell's equations N91-32733
**BUOYANCY**
Fully developed mixed convection in a horizontal pipe N91-32057
Turbulence models for natural convection flows along a vertical heated plane N91-32447
**BURNING RATE**
Studies in premixed combustion
[DE91-016964] N91-32198
**BUS CONDUCTORS**
Modeling and analysis of spacecraft battery charger systems N91-32411
**BUTENES**
Autoignition chemistry of C4 olefins under motored engine conditions: A comparison of experimental and modeling results
[DE91-016511] N91-32197
**BYPASSES**
Characteristics of winter lightning currents struck an isolated tower N91-32607

## C

**C-135 AIRCRAFT**
Medical evaluations on the KC-135 1990 flight report summary
[NASA-TM-104740] N91-32776
Health maintenance facility: Dental equipment requirements N91-32777
Mini-rack testbed evaluation N91-32779
**C-160 AIRCRAFT**
FD-TD calculation with composite materials. Application to C160 aircraft measurements N91-32637
FD-TD numerical simulation of an entire lightning strike on the C160 aircraft N91-32648
**CADMIUM**
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application
[NASA-TM-103551] N91-32217
**CALCIUM COMPOUNDS**
Laser heated calcium sulfate TLD plates: Application to radiation mapping N91-32364
**CALIBRATING**
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
Initial pointing calibrations for the DSS 13 34-meter beam-waveguide antenna N91-32267
Efficiency calibration of the DSS 13 34-meter diameter beam waveguide antenna at 8.45 and 32 GHz N91-32271
Calibration of ASIC library for radiation tolerant space applications methodology and experiment N91-32334
The United Kingdom waveguide power standards above 40 GHz
[NPL-DES-105] N91-32395
A new approach to equipment testing N91-32639
Calibration source for electron cyclotron emission measurements
[NIFS-19] N91-32913
**CALIFORNIUM ISOTOPES**
Characterization of 256 Kbits SRAMs under californium 252 and protons irradiations N91-32359
**CALORIMETERS**
The United Kingdom waveguide power standards above 40 GHz
[NPL-DES-105] N91-32395
**CAMERAS**
Model calculations for a pushbroom stereo camera: The case of the Mars 94 High Resolution Stereo Camera (HRSC)
[DLR-FB-90-57] N91-32468
**CANOPIES (VEGETATION)**
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
**CANTILEVER BEAMS**
Ion implantation effects in crystalline quartz
[DE91-016192] N91-32977
**CAPACITANCE**
Some recent studies with the solid-ionomer electrochemical capacitor N91-32562
**CAPACITORS**
Stress states in wound capacitors
[DE91-016402] N91-32400

Performance of a 10 kV, 625 kA, 85 kJ energy discharge module utilizing a solid dielectric switch
[DE91-017432] N91-32409
High average power magnetic modulator for copper lasers
[DE91-016560] N91-32482
Some recent studies with the solid-ionomer electrochemical capacitor N91-32562
A simulated lightning effects test facility for testing live and inert missiles and components N91-32725
High current pulse testing for ground rod integrity N91-32737

**CAPE KENNEDY LAUNCH COMPLEX**
Lightning mapping system N91-32713

**CARBIDES**
A study of fracture mechanisms in ATD roller bearing
[NASA-CR-184200] N91-32497

**CARBON**
Structural characterization of high temperature composites
[NASA-CR-187220] N91-32180
Shock-vaporization studies on zinc and porous carbon
[DE91-017846] N91-32233

**CARBON DIOXIDE**
Natural gas conversion process
[DE91-015759] N91-32235
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
Beta measurements N91-32681

**CARBON DIOXIDE LASERS**
Polarization effects, tasks 3 and 4
[NASA-CR-184219] N91-32221
Refinement of a pulsed CO2-laser rangefinder with heterodyne detection
[FEL-90-A303] N91-32477
Computer modeling of pulsed CO2 lasers for lidar applications N91-32680

**CARBON FIBER REINFORCED PLASTICS**
Guidelines for carbon and other advanced fibre prepreg procurement specifications
[ESA-PSS-03-207-ISSUE-1] N91-32176
Lightning protection of the Fokker 100 CFRP rudder N91-32612

**CARBON FIBERS**
High-temperature thermomechanical behavior of carbon-phenolic and carbon-carbon composites N91-32171
Tests of salinic clouds in test tube of the 7075 carbon fiber with metal mesh (Airbus 330/340)
[INFORME-I-520/90] N91-32175
Investigations into the damage for various types of unprotected carbon fibre composites with a variety of lightning arc attachments N91-32606
The electromagnetic environment in CFC structures N91-32638

**CARBON MONOXIDE**
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551

**CARBON STEELS**
Microstructural change and its influence on stress-strain behavior of two superplastic materials
[DE91-017431] N91-32980

**CARBON-CARBON COMPOSITES**
High-temperature thermomechanical behavior of carbon-phenolic and carbon-carbon composites N91-32171

**CARBONYL COMPOUNDS**
Sampling of atmospheric carbonyl compounds for determination by liquid chromatography after 2,4-dinitrophenylhydrazine labelling
[DE91-015842] N91-32585

**CARCINOGENS**
Biophysical and biomathematical adventures in radiobiology
[DE91-017484] N91-32750
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770

**CARDIOVASCULAR SYSTEM**
Evaluation of cardiopulmonary resuscitation techniques in microgravity N91-32789

**CARRIER FREQUENCIES**
Carrier-to-noise power estimation for the Block 5 Receiver N91-32275

**CARTESIAN COORDINATES**
Parabolized Navier-Stokes methods for hypersonic flows N91-32433

**CASCADE FLOW**
Numerical turbulent simulations of unsteady transonic cascade flows N91-32063
Unsteady flow analysis in two-dimensional compressor cascade N91-32064
Numerical analysis of three-dimensional cascade flow N91-32067
Navier-Stokes computations of three-dimensional turbine cascade flows N91-32068
Application of 3-D Navier-Stokes computation to turbine vane design N91-32069
Calculation of unsteady linearized Euler flows in cascades using harmonically deforming grids
[NASA-CR-188916] N91-32442

**CASE HISTORIES**
Design of the Digital Sky Survey DA and online system: A case history in the use of computer aided tools for data acquisition system design
[DE91-016469] N91-33032

**CASSEGRAIN OPTICS**
Initial pointing calibrations for the DSS 13 34-meter beam-waveguide antenna N91-32267

**CASTING**
Development of a spray-forming process for steel
[DE91-015812] N91-32218

**CATALYSTS**
Catalytic combustion of methane
[PB91-206391] N91-32190
New directions for the catalytic conversion of methane
[PB91-206417] N91-32191
The effect of chemical additives on the synthesis of ethanol
[DE91-016586] N91-32192
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551
Impact of fundamental technical improvements to natural gas fuel cells
[PB91-206615] N91-32570

**CATALYTIC ACTIVITY**
Natural gas conversion process
[DE91-015759] N91-32235

**CATASTROPHE THEORY**
L to H mode transitions and associated phenomena in divertor tokamaks
[DE91-017074] N91-32940

**CATHETERIZATION**
ATLS: Catheter and tube placement N91-32782
Venipuncture and intravenous infusion access during zero-gravity flight N91-32788

**CATHODES**
Current status of solid-state lithium batteries employing solid redox polymerization cathodes
[DE91-016988] N91-32404
Sodium-metal chloride battery research at JPL N91-32566
Impact of fundamental technical improvements to natural gas fuel cells
[PB91-206615] N91-32570

**CATIONS**
Evidence for cation disorder in in-situ grown YBaCuO superconducting films
[DE91-016760] N91-32971

**CAVITATION FLOW**
Numerical analysis of bubbly liquid in convergent-divergent nozzle N91-32052

**CAVITY RESONATORS**
Applications of synchroscan and dual-sweep streak camera techniques to free-electron laser experiments
[DE91-016017] N91-32479
Interferometric results from Boeing grazing incidence ring resonator FEL
[DE91-016305] N91-32484

**CELL ANODES**
Performance of a dual anode nickel-hydrogen cell N91-32563

**CELL CATHODES**
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551

**CENTAUR LAUNCH VEHICLE**
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656

**CENTRIFUGAL FORCE**
Turbulence model calculations on the effects of body forces on turbulent flows in a pipe N91-32056
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525

**CERAMIC COATINGS**
Ceramic coatings on smooth surfaces
[NASA-CASE-LEW-15164-2] N91-32229

**CERAMIC MATRIX COMPOSITES**
Structural characterization of high temperature composites
[NASA-CR-187220] N91-32180

**CERAMICS**
Projects within the Center for Advanced Materials
[PB91-205716] N91-32178
Reaction sintering of ZnO-Al2O3
[DE91-016254] N91-32210
Silver lined ceramic vessel and method of preparation
[AD-D014953] N91-32224
Advances in the design of toughened ceramics
[DE91-016767] N91-32228
Materials qualification technology for ceramic cross-flow filters
[DE91-017715] N91-32232
Surface mount on ceramic: How to achieve a space quality level N91-32309
Tribological behavior of silver films prepared on ceramic surfaces by ion-beam-assisted deposition
[DE91-017306] N91-32505
Analytical and numerical studies of fracture and fatigue in ceramic materials N91-32516

**CEREBRAL CORTEX**
Learning-logic: Casting the cortex of the human brain in silicon
[MIT-TR-47] N91-32840

**CERENKOV COUNTERS**
EXAM: A search for extragalactic antimatter N91-33035

**CERIUM COMPOUNDS**
Inconsistencies with the single impurity Undersign model in photoelectron spectra of cerium heavy fermion compounds
[DE91-016239] N91-32878

**CERTIFICATION**
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
Qualification status of hybrid crystal oscillators style OTO 16S for space application N91-32322
An advanced testability concept for space applications N91-32323
Certification of lightning protection for a full-authority digital engine control N91-32718

**CESIUM**
Emittance variations in current-amplifying ion induction linacs
[DE91-016266] N91-32909

**CHANNEL FLOW**
Wall function method with conservation property N91-32058
Numerical study of partitioned turbulence
[ONERA-RSF-20/3419-AY-124A] N91-32437
Channel flow of a concentrated suspension
[DE91-016649] N91-32453
A k-epsilon modeling of near wall turbulence
[NASA-TM-105238] N91-32460

**CHANNELS (DATA TRANSMISSION)**
Propagation limitations for transionospheric systems from 10 to 300 GHz N91-32243
Channel assignments and array gain bounds for the Ka-band array feed compensation system N91-32263
Multi-dimensional modulation codes for fading channel
[NASA-CR-188959] N91-32288

**CHAOS**
Hamiltonian chaos and transport in quasigeostrophic flows
[DE91-017385] N91-32464
Research highlights: June 1990 - May 1991 N91-32676

**CHARACTERIZATION**
Materials and processes laboratory composite materials characterization task, part 1. Damage tolerance
[NASA-TM-103553] N91-32185

**CHARGE COUPLED DEVICES**
Space radiation effects on CCDs N91-32339
Further proton damage effects in EEV CCDs N91-32340
Total dose effects on Charge Coupled Devices (CCD) reverse annealing phenomena N91-32341

**CHARGE EFFICIENCY**
Physical and chemical analysis of a Ni/H2 cell N91-32555
Performance of a dual anode nickel-hydrogen cell N91-32563
Small capacity, low cost (Ni-H2) design concept for commercial, military, and higher-volume aerospace applications N91-32565

**CHARGE EXCHANGE**
Ion beam sputtering in electric propulsion facilities
[NASA-TM-105145] N91-32158
Giant resonances in single and double charge exchange
[DE91-017822] N91-32900
Single- and double-charge exchange at low pion energies
[DE91-017829] N91-32901

**CHARGE TRANSFER**
Dynamics of charge-transfer excited states relevant to photochemical energy conversion
[DE91-017710] N91-32578
Scale-model charge-transfer technique for measuring enhancement factors N91-32651
Charge transfer during individual collisions in ice growing by riming N91-32727

**CHARGED PARTICLES**
On error sources during airborne measurements of the ambient electric field N91-32719
Optimal parameters of leader development in lightning N91-32723
Basic features of coherent radiation generated by relativistic charge bunches
[DE91-017656] N91-32898
L to H mode transitions and associated phenomena in divertor tokamaks
[DE91-017074] N91-32940
**CHEBYSHEV APPROXIMATION**
On polynomial preconditioning for indefinite Hermitian matrices
[NASA-CR-188857] N91-32814
**CHEMICAL ANALYSIS**
Rosetta/CNSR: A comet-nucleus sample-return mission and system definition document
[ESA-SP-1125] N91-32152
Annular denuder systems: Precision and applicability to stratospheric sampling N91-32532
Chemical tracer studies at IOSDL-2: A method manual for the routine measurement of chlorofluocarbons in seawater and air
[IOS-275] N91-32580
Precision metering of microliter volumes of biological fluids in micro-gravity N91-32792
Alleviation of interferences and reduction of sample memory in inductively coupled plasma mass spectrometry
[DE91-016399] N91-32943
**CHEMICAL ATTACK**
Development of procedures for verification of alleged use of chemical warfare agents: Application of procedures after a simulated attack on an air base
[FFI-91/6006] N91-32148
**CHEMICAL BONDS**
Multiheteromacrocycles that complex metal ions
[DE91-016292] N91-32205
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium
[DE91-016161] N91-32964
**CHEMICAL COMPOSITION**
Spectroscopic wear detector
[NASA-CASE-LEW-15200-1] N91-32167
Heat transfer effectiveness of a thermal barrier coating with different fuel compositions
[DE91-015602] N91-32222
Thermal-mechanical and physical-chemical properties of phosphate laser glasses
[DE91-016604] N91-32227
Measurements N91-32530
Annular denuders for use in global climate and stratospheric measurements of acidic gases and particles N91-32531
Annular denuder systems: Precision and applicability to stratospheric sampling N91-32532
Physical and chemical analysis of a Ni/H2 cell N91-32555
On the nonlinear response of minor atmospheric species to linear gravity waves N91-32593
Atmospheres of comets: Gas dynamic models and inference of kinematic parameters N91-33036
**CHEMICAL EQUILIBRIUM**
The Navy/NASA Engine Program (NNEP89): Interfacing the program for the calculation of complex Chemical Equilibrium Compositions (CEC)
[NASA-CR-187208] N91-32141
A new approximate sum rule for bulk alloy properties
[NASA-TM-105282] N91-32204
Fundamental metallurgical considerations in brazing and soldering
[DE91-016224] N91-32209
**CHEMICAL EVOLUTION**
Nuclear and astronomical constraints on the site for r-process nucleosynthesis
[DE91-016561] N91-33038
**CHEMICAL PROPERTIES**
Thermal-mechanical and physical-chemical properties of phosphate laser glasses
[DE91-016604] N91-32227
**CHEMICAL REACTIONS**
Investigation of radiative interactions in supersonic internal flows
[NASA-CR-188820] N91-32078
High octane ethers from synthesis gas-derived alcohols
[DE91-016596] N91-32193
Reaction sintering of ZnO-Al2O3
[DE91-016254] N91-32210
**CHEMICAL TESTS**
Development of procedures for verification of alleged use of chemical warfare agents: Application of procedures after a simulated attack on an air base
[FFI-91/6006] N91-32148
**CHEMICAL WARFARE**
Development of procedures for verification of alleged use of chemical warfare agents: Application of procedures after a simulated attack on an air base
[FFI-91/6006] N91-32148
**CHIPS (ELECTRONICS)**
Testing interconnected VLSI circuits in the Big Viterbi Decoder N91-32265
Assessment of DFT strategies N91-32301
Direct influence of chip design and material composition on GaAs/GaAlAs laser diodes reliability N91-32307
High performance packages for space applications N91-32311
Qualification strategy for multi-chip packaging for space applications N91-32312
Surface mount technology on PCBs at Alcatel Espace N91-32326
Test chips and ASIC qualification N91-32327
MTSL-005: Reliability evaluation of high pincount hermetic ceramic packages for space applications N91-32328
Specification, procurement and testing of passivated microwave semiconductor chips for space applications N91-32393
**CHIRP**
Polarization effects, tasks 3 and 4
[NASA-CR-184219] N91-32221
**CHLOROCARBONS**
Chemical tracer studies at IOSDL-2: A method manual for the routine measurement of chlorofluocarbons in seawater and air
[IOS-275] N91-32580
**CHLOROFLUOROMETHANE**
Chemical tracer studies at IOSDL-2: A method manual for the routine measurement of chlorofluocarbons in seawater and air
[IOS-275] N91-32580
**CHLOROPHYLLS**
Particulate models of photosynthesis
[DE91-016842] N91-32751
The role of spin chemistry in the primary events of photosynthesis
[DE91-017301] N91-32752
**CHOLESKY FACTORIZATION**
Highly parallel sparse Cholesky factorization
[NASA-CR-188875] N91-32847
**CHROMIUM**
Irradiation-induced chromium depletion and its influence on integranular stress corrosion cracking of stainless steels
[DE91-017418] N91-32212
**CHROMIUM STEELS**
Effect of prior mechanical deformation on hydrogen transport through 13 percent chromium martensitic stainless steel
[NPL-DMM(A)-14] N91-32202
**CIRCUIT BOARDS**
Surface mount on ceramic: How to achieve a space quality level N91-32309
Surface mount technology on PCBs at Alcatel Espace N91-32326
The repair and modification of printed-circuit board assemblies for space use
[ESA-PSS-01-728-ISSUE-2] N91-32422
**CIRCUIT PROTECTION**
Circuit protection devices for transient suppression N91-32732
**CIRCUIT RELIABILITY**
Digital ASIC design for space applications N91-32300
Simulation of radiation induced circuit failure modes in SOS integrated circuits N91-32351
The merits of an independent pre-cap inspection N91-32378
Progress in submicron technologies N91-32394
**CIRCUITS**
Design and testing of an active quenching circuit for an avalanche photodiode photon detector N91-32258
Characteristics of winter lightning currents struck an isolated tower N91-32607
**CITIES**
A guidebook for the control of summer heat islands
[DE91-016246] N91-32586
**CIVIL AVIATION**
The First Annual International Satellite Surveillance and Communication Symposium
[DOT/FAA/RD-91/21] N91-32093
Automatic Dependent Surveillance (ADS) Program summary N91-32094
Satellite Communications (SATCOM) N91-32095
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
International Civil Aviation Organization (ICAO) Automatic Dependent Surveillance Panel (ADSP) activities N91-32097
International program summary N91-32098
ADS (Automatic Dependent Surveillance) PET (Pacific Engineering Trial) program in Japan N91-32100
Australian experiments in Automatic Dependent Surveillance (ADS) including the Pacific Engineering Trials (PET) N91-32101
Automatic Dependent Surveillance (ADS) development in Canada N91-32104
Satellite data link research and development program in Japan N91-32108
SITA satellite air communications implementation N91-32113
An example of requirements for Advanced Subsonic Civil Transport (ASCT) flight control system using structured techniques
[NASA-CR-187526] N91-32132
**CLIMATE**
Parallelizing the spectral transform method, part 2
[DE91-017131] N91-32456
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
Geoengineering the climate
[DE91-017654] N91-32589
Climate dynamics experiments using a GCM simulations N91-32663
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687
Monitoring, analyzing, and modeling global climate N91-32689
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida
[DE91-017445] N91-32743
Parallel scalability of the spectral transform method
[DE91-017991] N91-32744
**CLIMATE CHANGE**
Annular denuders for use in global climate and stratospheric measurements of acidic gases and particles N91-32531
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539
Report of the expert group on global baseline datasets
[WCDP-11] N91-32598
Precipitation regime changes associated with climatic changes
[PB91-206656] N91-32740
Historical sunshine and cloud data in the United States
[DE91-016825] N91-32741
Climate research system
[DE91-016903] N91-32742
**CLIMATOLOGY**
International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects
[NASA-CP-3114] N91-32528
Annular denuders for use in global climate and stratospheric measurements of acidic gases and particles N91-32531
Naval arctic manual, ATP 17(A)
[PB91-193920] N91-32584
Monitoring, analyzing, and modeling global climate N91-32689
Tropical Pacific moisture variability N91-32690
Historical sunshine and cloud data in the United States
[DE91-016825] N91-32741
CLINEWS: NOAA Western Region computer programs and problems
[PB91-200709] N91-32831
**CLOTTING**
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
**CLOUD COVER**
Measurements in polar stratospheric clouds over Antarctica in September 1989 N91-32534
Historical sunshine and cloud data in the United States
[DE91-016825] N91-32741
**CLOUD PHYSICS**
Intracloud development of lightning strikes to aircraft N91-32602
**CLOUDS (METEOROLOGY)**
Laboratory and field studies of stratospheric aerosols: Phase changes under high supersaturation N91-32533
Intracloud development of lightning strikes to aircraft N91-32602
Electrical emissions of airplanes flying in electrified clouds and their effect on airplane measurements of cloud electric fields N91-32609
E and DE/DT waveshapes for narrow bipolar pulses in intracloud lightning N91-32610
Characteristics of return stroke electric fields produced by lightning flashes at distances of 1 to 15 kilometers N91-32615
AMPR/SSMI data comparisons N91-32665

A system for mapping sources of VHF and electric field pulses from in-cloud lightning at KSC N91-32697
Historical sunshine and cloud data in the United States
[DE91-016825] N91-32741

**CLUTTER**
Synthetic aperture radar imagery of airports and surrounding areas: Study of clutter at grazing angles and their polarimetric properties
[NASA-CR-4398] N91-32088
Improvement in radar detection under scan-to-scan processing and scan rate reduction N91-32245

**CMOS**
Development of semiconductor test structures for reliability evaluation N91-32292
Optimization of CMOS technology and design for deep cryogenic analog circuits N91-32296
An 8 bit high performance ADC in silicon on sapphire N91-32302
Space qualification test and evaluation of JHU/APL designed ASICs N91-32315
Effects of design on total dose characteristics of ASIC technologies N91-32333
Radiation tolerant 1 micron CMOS technology N91-32335
Trends in latch-up sensitivity N91-32345
Single event upset sensitivity of a SRAM: An overview from testing procedures to device hardening (theme 2) N91-32346
Analog CMOS/SOS in radiative environments N91-32350
SOS material improvement for post total dose, radiation induced leakage reduction N91-32353
Measurements of proton upset induced in CMOS devices: Synthesis of CEA studies N91-32356
Characterization of 256 Kbits SRAMs under californium 252 and protons irradiations N91-32359
An approximate HSPICE model for orbit low noise analog bipolar NPN transistors
[DE91-017220] N91-32414

**COAGULATION**
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780

**COAL DERIVED GASES**
High octane ethers from synthesis gas-derived alcohols
[DE91-016596] N91-32193

**COAL GASIFICATION**
High octane ethers from synthesis gas-derived alcohols
[DE91-016596] N91-32193

**COASTS**
AMPR/SSMI data comparisons N91-32665

**COATING**
Surface modification of high-strength reinforcing fibers by plasma treatment
[DE91-016481] N91-32226

**COATINGS**
Lubrication with sputtered MoS2 films: Principles, operation, limitations
[NASA-TM-105292] N91-32216
Development of a spray-forming process for steel
[DE91-015812] N91-32218
Performance of a high T(sub c) superconducting ultra-low loss microwave stripline filter N91-32255
Simplified micromechanical equations for thermal residual stress analysis of coated fiber composites
[NASA-CR-187599] N91-32527
Analysis of polarization properties of shallow metallic gratings by an extended Rayleigh-Fano theory
[DE91-016982] N91-32835
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy
[DE91-016571] N91-32917
Fabrication of advanced x ray optics with magnetron mini-source arrays
[DE91-017093] N91-32919
Interaction of InGa liquid alloy coolant with gold coated optical materials
[DE91-017480] N91-32927

**COAXIAL CABLES**
Microwave blind mate coaxial connectors N91-32317
Performance of a 10 kV, 625 kA, 85 kJ energy discharge module utilizing a solid dielectric switch
[DE91-017432] N91-32409

**COBALT ISOTOPES**
Measurements of induced radioactivity in some LDEF samples
[DE91-016309] N91-32882

**COBALT 60**
Intercomparison of standards of absorbed dose between the USSR and the UK
[NPL-RSA(EXT)-17] N91-32874

**COCKPITS**
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
Human-centered aircraft automation: A concept and guidelines
[NASA-TM-103885] N91-32135

**COGNITION**
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms
[DE91-017245] N91-32774
Research into the interaction between high performance and cognitive skills in an intelligent tutoring system
[NASA-CR-188821] N91-32830

**COGNITIVE PSYCHOLOGY**
Cognitive cybernetics and human communication: The regulatory effects of prior knowledge N91-32771

**COHERENT RADIATION**
Coherent-state description of free-electron lasers
[DE91-017077] N91-32486
Basic features of coherent radiation generated by relativistic charge bunches
[DE91-017656] N91-32898
Coherent hard x ray focusing optics and applications
[DE91-017968] N91-32928

**COKE**
Natural gas conversion process
[DE91-015759] N91-32235

**COLD NEUTRONS**
International workshop on cold neutron sources
[DE91-017559] N91-32891

**COLLECTION**
Quality assurance of field screening
[DE91-016303] N91-32582

**COLLIMATORS**
Gamma ray collimator
[NASA-CASE-SSC-00013-1] N91-32515

**COLLISION AVOIDANCE**
A magneto-sensitive skin for robots in space
[NASA-CR-188956] N91-32512

**COLLISIONLESS PLASMAS**
Kinetic theory of RF current drive and helicity injection
[DE91-017388] N91-32946

**COLLOCATION**
Spline methods for conservation equations
[DE91-017152] N91-32867

**COLOR**
Color transparency: Enchantment and effort
[DE91-016951] N91-32890

**COMBUSTION**
Effect of initial conditions on combustion generated loads
[DE91-016646] N91-32194
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539
Thermodynamics of combustion in an enclosure
[DE91-016430] N91-32992

**COMBUSTION CHAMBERS**
Numerical calculation of flow for scramjet engine N91-32035
Numerical simulations of chemically reacting flow N91-32036

**COMBUSTION CHEMISTRY**
Autoignition chemistry of C4 olefins under motored engine conditions: A comparison of experimental and modeling results
[DE91-016511] N91-32197
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588

**COMBUSTION EFFICIENCY**
Effects of oxygen enrichment and fuel emulsification on diesel engine performance and emissions
[DE91-016520] N91-32506

**COMBUSTION PHYSICS**
Studies in premixed combustion
[DE91-016964] N91-32198
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588

**COMBUSTION PRODUCTS**
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588

**COMBUSTION STABILITY**
Studies in premixed combustion
[DE91-016964] N91-32198

**COMET NUCLEI**
Rosetta/CNSR: A comet-nucleus sample-return mission and system definition document
[ESA-SP-1125] N91-32152
Atmospheres of comets: Gas dynamic models and inference of kinematic parameters N91-33036

**COMETARY ATMOSPHERES**
Atmospheres of comets: Gas dynamic models and inference of kinematic parameters N91-33036

**COMETS**
Rosetta/CNSR: A comet-nucleus sample-return mission and system definition document
[ESA-SP-1125] N91-32152

**COMMERCIAL AIRCRAFT**
Aircraft accident report: Avianca, the Airline of Columbia, Boeing 707-321B, HK 2016, fuel exhaustion, Cove Neck, New York, January 25, 1990
[PB91-910404] N91-32087
Communications needs of the future air-ground interface N91-32125

**COMMUNICATION**
Future prospects for networking in the United States
[DE91-017359] N91-32849

**COMMUNICATION EQUIPMENT**
Results of the recent precipitation static flight test program on the Navy P-3B antisubmarine aircraft N91-32626

**COMMUNICATION NETWORKS**
ADS communications: A cornerstone N91-32105
Aeronautical mobile satellite services ESA-PRODAT/SITA AIRCOM service trials programme N91-32106
Operational oceanic air traffic control using satellite data link: Initial implementation N91-32121

**COMMUNICATION SATELLITES**
Satellite Communications (SATCOM) N91-32095
Aeronautical Mobile Satellite Service (AMSS) message and voice access request transit delay N91-32107
System improvements identified by the North Atlantic Systems Planning Group (NAT/SPG) as related to the capabilities of the Oceanic Display and Planning System (ODAPS) N91-32109
INMARSAT access approval N91-32110
Operational SATCOM: Moving from trials to service N91-32111
Communications needs of the future air-ground interface N91-32125
Experiences with components in the DFS-project: Seen from a customer's point of view N91-32366
A statistical evaluation of EEE-parts procurement data from telecommunication satellites N91-32368

**COMMUNICATION THEORY**
Cognitive cybernetics and human communication: The regulatory effects of prior knowledge N91-32771

**COMPARISON**
The language compatible arithmetic standard and Ada
[NPL-DITC-173/91] N91-32810
Intercomparison of standards of absorbed dose between the USSR and the UK
[NPL-RSA(EXT)-17] N91-32874
Environmental radioactivity measurement intercomparison exercise 1990
[NPL-RSA(EXT)-20] N91-32875

**COMPATIBILITY**
Materials compatibility issues for fabric composite radiators
[DE91-017556] N91-32186

**COMPENSATORS**
Active damping using a control structure interaction approach N91-32290

**COMPILERS**
Calibration of ASIC library for radiation tolerant space applications methodology and experiment N91-32334
Cray performance data from five benchmarks
[NASA-TM-105200] N91-32806
Ada issues in implementing ART-Ada
[NASA-CR-188941] N91-32838
Toward the efficient implementation of expert systems in Ada
[NASA-CR-188942] N91-32839

**COMPLEX SYSTEMS**
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms
[DE91-017245] N91-32774
Krylov subspace methods for complex non-Hermitian linear systems
[NASA-CR-188891] N91-32821
Feedback controlled optics with wavefront compensation
[NASA-CASE-NPO-18194-1-CU] N91-32924

**COMPONENT RELIABILITY**
Test chips and ASIC qualification N91-32327
Total dose characterization of new components for the ESA radiation effects database N91-32362
Results and considerations on failure investigations of components used for space equipment N91-32365
Experiences with components in the DFS-project: Seen from a customer's point of view N91-32366

Summary of EEE component anomalies encountered in the SPOT line of Earth observation satellites and lessons derived therefrom for future generations N91-32367
The history of space quality EEE parts in the United States N91-32370
EEC component procurement: A look ahead N91-32372
ESA's component programme plan N91-32373
Upscreening of components for space applications N91-32376
Space flight components database N91-32377
Component field failure data base N91-32380
A plan of NASDA's parts database in the reliability information system N91-32381
Preparing electronics quality for the next century N91-32382
Evaluation of advanced microelectronics for inclusion in MIL-STD-975 N91-32390
Is the ESA/SCC screening technique more efficient than the MIL specifications? N91-32392

**COMPOSITE MATERIALS**
Progressive fracture in composites subjected to hygrothermal environment [NASA-TM-105230] N91-32182
Failure mechanisms and prediction in advanced composite materials N91-32184
Surface modification of high-strength reinforcing fibers by plasma treatment [DE91-016481] N91-32226
Advances in the design of toughened ceramics [DE91-016767] N91-32228
FD-TD calculation with composite materials. Application to C160 aircraft measurements N91-32637

**COMPOSITE STRUCTURES**
Integrated mechanics for the passive damping of polymer-matrix composites and composite structures [NASA-TM-104346] N91-32181
Progressive fracture in composites subjected to hygrothermal environment [NASA-TM-105230] N91-32182
Failure mechanisms and prediction in advanced composite materials N91-32184
Lightning protection of the Fokker 100 CFRP rudder N91-32612
An assessment of tailoring of lightning protection design requirements for a composite wing structure on a metallic aircraft N91-32641
Lightning protection design and testing of an all composite wet wing for the Egrett N91-32642

**COMPRESSED AIR**
Supersonic inlet flow computations with cavity N91-32049

**COMPRESSED GAS**
Pressure safety training [DE91-015717] N91-32238

**COMPRESSIBLE FLOW**
Supersonic inlet flow computations with cavity N91-32049
Supersonic mixing enhancement by vorticity for high-speed propulsion [NASA-CR-188920] N91-32079
The development of solution algorithms for compressible flows N91-32423
Solution of perfect gas viscous flows via compressible Navier-Stokes equations with wallslip conditions [ONERA-RSF-13/3637-AY] N91-32435
Calculation of turbulent compressible flows N91-32445

**COMPRESSION TESTS**
Structural characterization of high temperature composites [NASA-CR-187220] N91-32180
Failure mechanisms and prediction in advanced composite materials N91-32184

**COMPRESSOR BLADES**
Review of Air Force compressor blade and vane rework and it's impact on performance and costs [AD-A229518] N91-32136

**COMPRESSORS**
Braun heat pump engine/compressor and its hermetic rod seal [DE91-017151] N91-32239

**COMPUTATION**
Influence of channel base current and varying return stroke speed on the calculated fields of three important return stroke models N91-32736

**COMPUTATIONAL FLUID DYNAMICS**
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics [NAL-SP-14] N91-32032
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034
Several issues of visualization techniques in computational fluid dynamics 2 N91-32044
Navier-Stokes simulation for complete aircraft configuration N91-32046
The role of computational fluid dynamics in aeronautical engineering (8): A mixed compression inlet for a supersonic airplane N91-32048
Numerical simulation analysis of sidewall effects in two-dimensional wind tunnels N91-32050
Application of 3-D Navier-Stokes computation to turbine vane design N91-32069
Aerodynamic computation post processing tools [AAAF-NT-89-20] N91-32073
Aerodynamics of combat aircraft controls and of ground effects [AGARD-AR-271] N91-32082
Computational Fluid Dynamics [VKI-LS-1991-01] N91-32426
A general analysis of two-dimensional convection schemes N91-32428
Stabilized finite element formulations for incompressible flow computations [UMSI-91/66] N91-32431
Parabolized Navier-Stokes methods for hypersonic flows N91-32433
An approximate Riemann solver for hypervelocity flows [NASA-CR-187629] N91-32463
Gigaflop performance on a CRAY-2: Multitasking a computational fluid dynamics application [NASA-TM-4305] N91-32841
Asymmetries in extragalactic radio sources N91-33050

**COMPUTATIONAL GRIDS**
Surface grid generation based on unstructured grid N91-32042
Unstructured-grid methods development for unsteady aerodynamic and aeroelastic analyses [NASA-TM-104143] N91-32084
Investigation of advanced counterrotation blade configuration concepts for high speed turboprop systems. Task 3: Advanced fan section grid generator final report and computer program user's manual [NASA-CR-187129] N91-32138
The development of solution algorithms for compressible flows N91-32423
The Euler and Navier-Stokes equations. Wellposedness, stability and composite grids N91-32427
Parabolized Navier-Stokes methods for hypersonic flows N91-32433
Spectral transfer analysis for subgrid-scale modelling N91-32438
Calculation of unsteady linearized Euler flows in cascades using harmonically deforming grids [NASA-CR-188916] N91-32442
Simulation of single mode Richtmyer-Meshkov instability using the adaptive free Lagrange method [DE91-017657] N91-32457
Multilevel filtering elliptic preconditioners [NASA-CR-188851] N91-32845
Mapping unstructured grid problems to the connection machine [NASA-CR-187719] N91-32864

**COMPUTER AIDED DESIGN**
Aerodynamic design of non-planar wing by inverse method with Navier-Stokes equation N91-32045
Blended wing-body configuration design using transonic inverse code N91-32047
CARPET: A versatile program for radar performance analysis [FEL-91-B002] N91-32246
An overview of the NASA electronic components information management system N91-32369
Human analogue models for computer-aided design and engineering applications [AD-A229520] N91-32775
Computation applied to particle accelerator simulations [DE91-017128] N91-32906
Design of the Digital Sky Survey DA and online system: A case history in the use of computer aided tools for data acquisition system design [DE91-016469] N91-33032
Hanover University research report [ISSN-0723-1903] N91-33052

**COMPUTER AIDED MAPPING**
Interactive access and management for four-dimensional environmental data sets using McIDAS N91-32670

**COMPUTER AIDED TOMOGRAPHY**
Some stable reconstruction algorithms for electrical impedance tomography [DE91-016569] N91-32473

**COMPUTER ANIMATION**
Interactive access and management for four-dimensional environmental data sets using McIDAS N91-32670
Vehicle Animation Software (VAS) to animate results obtained from vehicle handling and rollover simulations and tests [PB91-194142] N91-32832

**COMPUTER ASSISTED INSTRUCTION**
An intelligent tutoring system for the investigation of high performance skill acquisition [NASA-CR-188827] N91-32827

**COMPUTER GRAPHICS**
Aerodynamic computation post processing tools [AAAF-NT-89-20] N91-32073

**COMPUTER NETWORKS**
US oceanic air traffic control: Past, present, and future N91-32118
Data Multiplexing Network (DMN), phase 3: Equipment Operational Test and Evaluation (OT&E)/Integration test plan [DOT/FAA/CT-TN91/24] N91-32283
Gas tungsten arc adaptive welding [DE91-017848] N91-32513
Mutual exclusion [NASA-CR-188122] N91-32822
Feasibility study on the use of groupware support for NASA source evaluation boards [NASA-CR-188832] N91-32824
Future prospects for networking in the United States [DE91-017359] N91-32849
Parallel computing and domain decomposition [DE91-017967] N91-32854
Present and future supercomputer network architectures [DE91-018035] N91-32855
What's happening with supercomputer networks? [DE91-018035] N91-32856

**COMPUTER PROGRAMMING**
GEOPLOT: User guide and programmer's guide [IOS-279] N91-32745
Automated IDEF3 and IDEF4 systems design specification document [NASA-CR-188830] N91-32803
IDEF3 and IDEF4 automation system requirements document and system environment models [NASA-CR-188829] N91-32804
Programming in a proposed 9X distributed Ada [NASA-CR-188831] N91-32825
Advanced Software Development Workstation Project, phase 3 [NASA-CR-188824] N91-32828
Advanced software development workstation project ACCESS user's guide [NASA-CR-188823] N91-32829
Research into the interaction between high performance and cognitive skills in an intelligent tutoring system [NASA-CR-188821] N91-32830
ART-Ada: An Ada-based expert system tool [NASA-CR-188930] N91-32837
From an automated flight-test management system to a flight-test engineer's workstation [NASA-TM-104242] N91-32851
Noise levels of USAF aircraft in exercise Luce Belle [NPL-RSA(EXT)-16] N91-32873

**COMPUTER PROGRAMS**
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034
Application of 3-D Navier-Stokes computation to turbine vane design N91-32069
Aerodynamic computation post processing tools [AAAF-NT-89-20] N91-32073
Aeronautical Mobile Satellite Service (AMSS) message and voice access request transit delay N91-32107
The Navy/NASA Engine Program (NNEP89): Interfacing the program for the calculation of complex Chemical Equilibrium Compositions (CEC) [NASA-CR-187208] N91-32141
High-temperature thermomechanical behavior of carbon-phenolic and carbon-carbon composites N91-32171
Progressive fracture in composites subjected to hygrothermal environment [NASA-TM-105230] N91-32182
Delaminations in composite plates under transverse static or impact loads N91-32183
CARPET: A versatile program for radar performance analysis [FEL-91-B002] N91-32246
Wideband waveguide polarizer development for SETI N91-32277
Initial testing of a two-dimensional computer code for microwave-induced surface breakdown in air [DE91-015763] N91-32286
Component local velocities of a ship along a defined axis [ARE-TM(UHR)-91305] N91-32424
Smart instruments and the national collaboratory [NASA-CR-188902] N91-32472

Simulation of APLE photoinjector
[DE91-018048] N91-32493
Inherently safe nuclear-driven internal combustion engines
[DE91-016568] N91-32503
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
The Sandia transportable triggered lightning instrumentation facility N91-32636
FD-TD calculation with composite materials. Application to C160 aircraft measurements N91-32637
The electromagnetic environment in CFC structures N91-32638
Basic studies of baroclinic flows N91-32662
A theoretical analysis of the electromagnetic environment of the AS330 super Puma helicopter external and internal coupling N91-32701
Three-dimensional time domain model of lightning including corona effects N91-32702
Workshop on NASA workstation technology
[NASA-CR-188866] N91-32800
A VDM-SL specification for the VI pattern matcher
[NPL-DITC-171/91] N91-32808
Approved Ada uniformity issues
[NPL-DITC-172/91] N91-32809
User documentation for the MSK and OMS intelligent tutoring systems
[NASA-CR-188815] N91-32823
Machine learning research 1989-90
[NASA-CR-188828] N91-32826
Advanced software development workstation project ACCESS user's guide
[NASA-CR-188823] N91-32829
Vehicle Animation Software (VAS) to animate results obtained from vehicle handling and rollover simulations and tests
[PB91-194142] N91-32832
User's manual for PANDA 2: A computer code for calculating equations of state
[DE91-017717] N91-32843
Atomic and molecular collision processes
[DE91-017649] N91-32897
The comparison and selection of programming languages for high energy physics applications
[DE91-017130] N91-32910
Mechanisms of defect production and atomic mixing in high energy displacement cascades: A molecular dynamics study
[DE91-017082] N91-32979
The use of software metrics to evaluate information systems N91-33003
Additions to Mars Global Reference Atmospheric Model (Mars-GRAM)
[NASA-CR-188924] N91-33045

**COMPUTER STORAGE DEVICES**
The pre-screening of large semiconductor memories for space application N91-32357

**COMPUTER SYSTEMS DESIGN**
Application of AI to engineering problems N91-32033
On the parallel processing of Direct Simulation Monte Carlo method N91-32037
WetNet operations N91-32668
Automated IDEF3 and IDEF4 systems design specification document
[NASA-CR-188830] N91-32803
Highly parallel computer architecture for robotic computation
[NASA-CASE-NPO-17632-1-CU] N91-32805
Feasibility study on the use of groupware support for NASA source evaluation boards
[NASA-CR-188832] N91-32824
Programming in a proposed 9X distributed Ada
[NASA-CR-188831] N91-32825
Machine learning research 1989-90
[NASA-CR-188828] N91-32826
Advanced Software Development Workstation Project, phase 3
[NASA-CR-188824] N91-32828
Research into the interaction between high performance and cognitive skills in an intelligent tutoring system
[NASA-CR-188821] N91-32830
Parallel computing and domain decomposition
[DE91-017967] N91-32854
Equations of learning and capacity of layered neural networks
[AD-A229633] N91-32857
Design of the Digital Sky Survey DA and online system: A case history in the use of computer aided tools for data acquisition system design
[DE91-016469] N91-33032

**COMPUTER SYSTEMS PERFORMANCE**
On the parallel processing of Direct Simulation Monte Carlo method N91-32037
Improvement in radar detection under scan-to-scan processing and scan rate reduction N91-32245
Delta VLBI data performance in the Galileo spacecraft Earth flyby of December 1990 N91-32274
Non volatile solid state magnetic memory technologies N91-32294
Lanczos eigensolution method for high-performance computers
[NASA-TM-104108] N91-32526
Parallel scalability of the spectral transform method
[DE91-017991] N91-32744
Automated IDEF3 and IDEF4 systems design specification document
[NASA-CR-188830] N91-32803
Cray performance data from five benchmarks
[NASA-TM-105200] N91-32806
Feasibility study on the use of groupware support for NASA source evaluation boards
[NASA-CR-188832] N91-32824
Programming in a proposed 9X distributed Ada
[NASA-CR-188831] N91-32825
Advanced Software Development Workstation Project, phase 3
[NASA-CR-188824] N91-32828
Research into the interaction between high performance and cognitive skills in an intelligent tutoring system
[NASA-CR-188821] N91-32830
Future prospects for networking in the United States
[DE91-017359] N91-32849
Parallel computing and domain decomposition
[DE91-017967] N91-32854
Present and future supercomputer network architectures
[DE91-018035] N91-32855
Equations of learning and capacity of layered neural networks
[AD-A229633] N91-32857
Distributed memory approaches for robotic neural controllers
[NASA-CR-188865] N91-32859
Evaluation of knowledge-based system development tools
[DE91-017241] N91-32860

**COMPUTER SYSTEMS PROGRAMS**
ESA software engineering standards, issue 2
[ESA-PSS-05-0-ISSUE-2] N91-32811
WASP, the Weapon Analysis and Simulation Program
[FEL-90-A322] N91-32813

**COMPUTER TECHNIQUES**
Wideband waveguide polarizer development for SETI N91-32277
Smart instruments and the national collaboratory
[NASA-CR-188902] N91-32472
Advanced visualization techniques N91-32669
Workshop on NASA workstation technology
[NASA-CR-188866] N91-32800
Collaboration technology and space science
[NASA-CR-188861] N91-32846

**COMPUTER VISION**
An analog retina model for detecting moving objects against a moving background
[DE91-017428] N91-32544

**COMPUTERIZED SIMULATION**
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics
[NAL-SP-14] N91-32032
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034
Numerical calculation of flow for scramjet engine N91-32035
Numerical simulations of chemically reacting flow N91-32036
On the parallel processing of Direct Simulation Monte Carlo method N91-32037
Conservation of angular momentum in direct simulation Monte Carlo method N91-32038
Rarefied gas numerical wind tunnel 6: Delta wing N91-32039
An incompressible flow solver N91-32040
Navier-Stokes simulation for complete aircraft configuration N91-32046
Numerical simulation of shock wave emanating from a square shock tube N91-32061
Aerodynamic computation post processing tools
[AAAF-NT-89-20] N91-32073
Aeronautical Mobile Satellite Service (AMSS) message and voice access request transit delay N91-32107
Investigation of advanced counterrotation blade configuration concepts for high speed turboprop systems. Task 3: Advanced fan section grid generator final report and computer program user's manual
[NASA-CR-187129] N91-32138
RV strings of maximum curvature
[DE91-016708] N91-32157
Progressive fracture in composites subjected to hygrothermal environment
[NASA-TM-105230] N91-32182
Numerical study of partitioned turbulence
[ONERA-RSF-20/3419-AY-124A] N91-32437
Parallelizing the spectral transform method, part 2
[DE91-017131] N91-32456
Simulation of single mode Richtmyer-Meshkov instability using the adaptive free Lagrange method
[DE91-017657] N91-32457
Fluid dynamics of double diffusive systems
[DE91-017401] N91-32465
Spontaneous emission from free electron lasers
[DE91-017820] N91-32491
A reference model dynamics-CMAC algorithm for simulation and control of robotic manipulators N91-32507
An analog retina model for detecting moving objects against a moving background
[DE91-017428] N91-32544
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
The Sandia transportable triggered lightning instrumentation facility N91-32636
FD-TD calculation with composite materials. Application to C160 aircraft measurements N91-32637
Basic studies of baroclinic flows N91-32662
Climate dynamics experiments using a GCM simulations N91-32663
Computer modeling of pulsed CO2 lasers for lidar applications N91-32680
Lightning induced currents in aircraft wiring using low level injection techniques N91-32694
Electron distribution functions in electric field environments N91-32726
Gulf of Mexico circulation modeling study: Annual progress report: Years 3 and 4
[PB91-210666] N91-32746
Human analogue models for computer-aided design and engineering applications
[AD-A229520] N91-32775
WASP, the Weapon Analysis and Simulation Program
[FEL-90-A322] N91-32813
Vehicle Animation Software (VAS) to animate results obtained from vehicle handling and rollover simulations and tests
[PB91-194142] N91-32832
GOOSE: A Generalized Object-Oriented Simulation Environment
[DE91-016771] N91-32842
User's manual for PANDA 2: A computer code for calculating equations of state
[DE91-017717] N91-32843
Atomic and molecular collision processes
[DE91-017649] N91-32897
Computer simulation studies of high energy collision cascades
[DE91-016225] N91-32903
Computation applied to particle accelerator simulations
[DE91-017128] N91-32906
Macroscale implicit, electromagnetic particle simulation of inhomogeneous and magnetized plasmas in multi-dimensions
[NIFS-91] N91-32929
Mechanisms of defect production and atomic mixing in high energy displacement cascades: A molecular dynamics study
[DE91-017082] N91-32979

**COMPUTERS**
Application of AI to engineering problems N91-32033
Smart instruments and the national collaboratory
[NASA-CR-188902] N91-32472
Computing and data processing N91-33028

**COMSAT PROGRAM**
ADS communications: A cornerstone N91-32105

**CONCATENATED CODES**
Frame error rate of the NASA concatenated coding system N91-32266

**CONCENTRATION (COMPOSITION)**
Further development of IDGS: Isotope dilution gamma-ray spectrometry
[DE91-016315] N91-32936

**CONCURRENT PROCESSING**
Mutual exclusion
[NASA-CR-188122] N91-32822

**CONDENSED MATTER PHYSICS**
Analogous behavior in the quantum hall effect, anyon superconductivity, and the standard model
[DE91-016609] N91-32970

**CONFERENCES**
Aerodynamics of combat aircraft controls and of ground effects
[AGARD-AR-271] N91-32082
The First Annual International Satellite Surveillance and Communication Symposium
[DOT/FAA/RD-91/21] N91-32093

Proceedings of 2nd US/FRG Workshop on Photochemical Ozone Problem and its Control
[PB91-211847] N91-32583
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1
[NASA-CP-3106-VOL-1] N91-32599
UJNR Tsunami Workshop Proceedings
[PB91-193656] N91-32747
International workshop on cold neutron sources
[DE91-017559] N91-32891
A political scenario for Europe: Pan-European security system
[FFI-91/5009] N91-33015

**CONFIGURATION MANAGEMENT**
Development of a handbook for configuration managers with applications for the program/system in full-scale development
[AD-A229617] N91-32993

**CONFINEMENT**
Geometric dependence of the scaling law on the energy confinement time in H-mode discharges
[NIFS-93] N91-32931

**CONJUGATE GRADIENT METHOD**
QMR: A Quasi-Minimal Residual method for non-Hermitian linear systems
[NASA-CR-188882] N91-32818
A biconjugate gradient type algorithm on massively parallel architectures
[NASA-CR-188888] N91-32848

**CONNECTORS**
Circuit protection devices for transient suppression N91-32732

**CONSERVATION**
Finiteness: On constraints of applied research
[DLR-MITT-91-06] N91-33001

**CONSERVATION LAWS**
Conservation of angular momentum in direct simulation Monte Carlo method N91-32038
Wall function method with conservation property N91-32058
Upwind methods and multidimensional splittings for the Euler equations N91-32429
Simulation of single mode Richtmyer-Meshkov instability using the adaptive free Lagrange method
[DE91-017657] N91-32457
Fracture characterization for thermoinelasticity N91-32517
Spline methods for conservation equations
[DE91-017152] N91-32867

**CONSTRAINTS**
Finiteness: On constraints of applied research
[DLR-MITT-91-06] N91-33001

**CONSTRUCTION**
High speed welding used in building metallic structures
[CRIF-MT-180] N91-32496

**CONSTRUCTION MATERIALS**
Adhesive bonding handbook for advanced structural materials
[ESA-PSS-03-210-ISSUE-1] N91-32234

**CONTACT LENSES**
Publications and presentations of the Opthalmology Branch, USAF School of Aerospace Medicine, 1981-1990
[AD-A239458] N91-32754

**CONTACT RESISTANCE**
Assessment of p-metallisations for high power GaAs laser diodes N91-32316

**CONTAINERS**
Manufacture of containers from an oriented biopolymer N91-32999

**CONTAINMENT**
Health maintenance facility: Dental equipment requirements N91-32777
Dental equipment test during zero-gravity flight N91-32778

**CONTAMINANTS**
Proceedings of 2nd US/FRG Workshop on Photochemical Ozone Problem and its Control
[PB91-211847] N91-32583

**CONTAMINATION**
Total dose effects in MOS systems: Influence of the initial hydrogen distribution N91-32338
Deployment and testing of a second prototype expandable surgical chamber in microgravity N91-32794

**CONTINUITY EQUATION**
Wall function method with conservation property N91-32058

**CONTINUOUS RADIATION**
Airborne CW lidar measurements of atmospheric backscatter at 9.1 and 10.6 microns N91-32677

**CONTINUUMS**
Spline methods for conservation equations
[DE91-017152] N91-32867
Giant resonances in single and double charge exchange
[DE91-017822] N91-32900

**CONTRACT MANAGEMENT**
Rationales for the selection of a parts procurement system (coordinated versus centralized) from a prime contractor point of view N91-32371

**CONTRAROTATING PROPELLERS**
Analysis of the aerodynamic performance of counter-rotating propeller by means of vortex lattice method N91-32065

**CONTROL SURFACES**
An experimental study of fluctuating pressure loads beneath swept shock/boundary-layer interactions
[NASA-CR-188919] N91-32080

**CONTROL SYSTEMS DESIGN**
An example of requirements for Advanced Subsonic Civil Transport (ASCT) flight control system using structured techniques
[NASA-CR-187526] N91-32132
Human-centered aircraft automation: A concept and guidelines
[NASA-TM-103885] N91-32135
Application of an integrated flight/propulsion control design methodology to a STOVL aircraft
[NASA-TM-105254] N91-32143
Control design variable linking for optimization of structural/control systems N91-32144
Development and evaluation of an inverse solution technique for studying helicopter maneuverability and agility
[NASA-TM-102889] N91-32145
Modeling and simulations of the DSS 13 antenna control system N91-32268
Active damping using a control structure interaction approach N91-32290
Modeling and analysis of spacecraft battery charger systems N91-32411
Dynamics modeling and control of a flexible robot arm N91-32495
A reference model dynamics-CMAC algorithm for simulation and control of robotic manipulators N91-32507
Lightning protection of full authority digital electronic systems N91-32643
Design of lightning protection for a full-authority digital engine control N91-32717

**CONTROL THEORY**
Optimal control problems with switching points
[NASA-CR-4393] N91-32155

**CONTROLLABILITY**
Vehicle Animation Software (VAS) to animate results obtained from vehicle handling and rollover simulations and tests
[PB91-194142] N91-32832

**CONTROLLERS**
The Telecommunications and Data Acquisition Report
[NASA-CR-188813] N91-32250
Telerobot control system
[NASA-CASE-NPO-18116-1-CU] N91-32509
A generalized compliant motion primitive
[NASA-CASE-NPO-18134-1-CU] N91-32510
Development of a sensor coordinated kinematic model for neural network controller training
[NASA-CR-188864] N91-32799

**CONVECTION**
Fully developed mixed convection in a horizontal pipe N91-32057
Research highlights: June 1990 - May 1991 N91-32676
Bifurcations and patterns in non-linear dissipative systems
[DE91-017402] N91-32984

**CONVECTIVE FLOW**
Fully developed mixed convection in a horizontal pipe N91-32057
Numerical simulation of thermal convection in a rectangular duct flow N91-32062
A general analysis of two-dimensional convection schemes N91-32428
Appraisal of the Suitability of Turbulence Models in Flow Calculations
[AGARD-AR-291] N91-32443
Laboratory and theoretical models of planetary-scale instabilities and waves N91-32675
Surface wind convergence as a short-term predictor of cloud-to-ground lightning at Kennedy Space Center: A four-year summary and evaluation N91-32703

**CONVECTIVE HEAT TRANSFER**
Fully developed mixed convection in a horizontal pipe N91-32057
Numerical simulation of thermal convection in a rectangular duct flow N91-32062
Numerical simulation of turbulent convection over wavy surfaces
[DLR-FB-91-12] N91-32439
Turbulence models for natural convection flows along a vertical heated plane N91-32447

**CONVERGENCE**
Surface wind convergence as a short-term predictor of cloud-to-ground lightning at Kennedy Space Center: A four-year summary and evaluation N91-32703
Multilevel filtering elliptic preconditioners
[NASA-CR-188851] N91-32845

**CONVERGENT-DIVERGENT NOZZLES**
Numerical analysis of bubbly liquid in convergent-divergent nozzle N91-32052

**CONVERSION TABLES**
Comparison of factors given in ICRU report 23 and IAEA TRS 277 for converting from exposure/air kerma to absorbed dose to water for medium energy x rays
[NPL-RSA(EXT)-15] N91-32147

**COOLANTS**
The NASA cryogenic fluid management technology program plan
[NASA-TM-105256] N91-32161
Interaction of InGa liquid alloy coolant with gold coated optical materials
[DE91-017480] N91-32927

**COOLING**
Site-specific investigations on aquifer thermal energy storage for space and process cooling
[DE91-017534] N91-32576

**COOLING FINS**
Multiple cell common pressure vessel nickel hydrogen battery N91-32564

**COOLING SYSTEMS**
The evolution of US helium-cooled blankets
[DE91-017938] N91-32952

**COPPER**
High average power magnetic modulator for copper lasers
[DE91-016560] N91-32482
Mechanisms of defect production and atomic mixing in high energy displacement cascades: A molecular dynamics study
[DE91-017082] N91-32979

**COPPER ALLOYS**
The role of anodic dissolution in the stress corrosion cracking of Al-Li-Cu alloy 2090
[DE91-016403] N91-32219
Graphite-metal brazing for thermal applications
[DE91-016647] N91-32944
Microstructural change and its influence on stress-strain behavior of two superplastic materials
[DE91-017431] N91-32980

**COPPER OXIDES**
Electronic transport properties in copper oxides
[DE91-018182] N91-32213
De Haas van Alphen effect in high temperature superconductors
[DE91-016198] N91-32397
High temperature superconductivity: The early 1991 edition
[DE91-017655] N91-32417
Neutron diffraction by the flux lattice in high-Tc superconductors
[DE91-017866] N91-32418
Neutron scattering from the flux lattice in high temperature superconductors
[DE91-017947] N91-32419
La(sup 139) NMR and NQR study of the temperature dependent structure of La2CuO4+(delta)
[DE91-016201] N91-32959
Critical currents in melt-textured YBa2Cu3O(x)
[DE91-016523] N91-32966
Evidence for cation disorder in in-situ grown YBaCuO superconducting films
[DE91-016760] N91-32971
Fermi surface measurements in YBa2Cu3O(7-x) and La(1.874)Sr(126)CuO4
[DE91-017094] N91-32973
Magnetic relaxation in a single crystal of YBa2Cu3O(x)
[DE91-017963] N91-32986
Critical currents in sputtered YBCO films
[DE91-017976] N91-32987

**CORIOLIS EFFECT**
Turbulence model calculations on the effects of body forces on turbulent flows in a pipe N91-32056
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525

**CORN**
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root
[DE91-016255] N91-32749

**CORONAS**
Three-dimensional time domain model of lightning including corona effects N91-32702

**COROTATION**
High resolution measurements of density structures in the Jovian plasma sheet
[NASA-CR-188918] N91-33043

**CORRELATION**
Orr-Sherby-Dorn creep strengths of the refractory-metal alloys C-103, ASTAR-811C, W-5Re, and W-25Re [NASA-TM-105228] N91-32165
Parametric rectification of thematic mapper raw data [DLR-FB-90-55] N91-32543
Correlation between some current parameters and optical radiation generated by 280 mm long laboratory sparks N91-32655

**CORROSION**
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application [NASA-TM-103551] N91-32217
Leaching behavior of microtektite glass compositions in sea water and the effect of precipitation on glass leaching [NASA-TM-105106] N91-32225
Corrosion and arc erosion in MHD channels [DE91-016829] N91-32939

**CORROSION PREVENTION**
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application [NASA-TM-103551] N91-32217

**CORROSION RESISTANCE**
Tests of salinic clouds in test tube of the 7075 carbon fiber with metal mesh (Airbus 330/340) [INFORME-I-520/90] N91-32175
Resistance of perished paints to Skydrol [INFORME-I-536/90] N91-32223

**CORROSION TESTS**
Tests of salinic clouds in test tube of the 7075 carbon fiber with metal mesh (Airbus 330/340) [INFORME-I-520/90] N91-32175
The role of anodic dissolution in the stress corrosion cracking of Al-Li-Cu alloy 2090 [DE91-016403] N91-32219
Corrosion and arc erosion in MHD channels [DE91-016829] N91-32939

**COSMIC DUST**
Atmospheres of comets: Gas dynamic models and inference of kinematic parameters N91-33036

**COSMIC RAY SHOWERS**
Hadronic photons and collider diffractive physics [DE91-016514] N91-32888

**COSMIC RAYS**
Heavy-ion induced single-event upset in integrated circuits N91-32347
Particle astrophysics N91-33024
EXAM: A search for extragalactic antimatter N91-33035

**COSMOCHEMISTRY**
Rosetta/CNSR: A comet-nucleus sample-return mission and system definition document [ESA-SP-1125] N91-32152

**COSMOLOGY**
Particle astrophysics N91-33024
Particle theory and cosmology [DE91-017730] N91-33041

**COST ANALYSIS**
The FAA/ARINC initial implementation of AMSS N91-32112
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
Modeling preparation costs for space missions by using major cost drivers N91-32279
Benefit/cost comparison for utility SMES applications [DE91-017425] N91-32408
Wafer cost analysis for a soft x ray projection lithography system [DE91-016605] N91-32918
Reliability and cost: A sensitivity analysis [NASA-TM-105293] N91-33014

**COST EFFECTIVENESS**
Cost effectiveness of two versus three levels of maintenance for turbine engines in the Air Force inventory [AD-A229622] N91-32137
A statistical evaluation of EEE-parts procurement data from telecommunication satellites N91-32368
Parts management for the 1990's N91-32375

**COST ESTIMATES**
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
Optimal cooperative time-fixed impulsive rendezvous N91-32153
Modeling preparation costs for space missions by using major cost drivers N91-32279
Benefit/cost comparison for utility SMES applications [DE91-017425] N91-32408
Wafer cost analysis for a soft x ray projection lithography system [DE91-016605] N91-32918

**COST REDUCTION**
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
Cost effective electronic components for short life space missions N91-32387
ABB Hafo's ESA approved capability domain for CMOS/SOS ASICs N91-32388
Technology approval using capability indices N91-32389

**COSTS**
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
Satellite surveillance and communications airline benefits: The telephone myth N91-32124
Quality assurance of field screening [DE91-016303] N91-32582

**COUNTER ROTATION**
Investigation of advanced counterrotation blade configuration concepts for high speed turboprop systems. Task 3: Advanced fan section grid generator final report and computer program user's manual [NASA-CR-187129] N91-32138

**COUPLES**
Two fault tolerant toggle-hook release [NASA-CASE-MSC-21671-1] N91-32498

**COUPLING COEFFICIENTS**
Alleviation of interferences and reduction of sample memory in inductively coupled plasma mass spectrometry [DE91-016399] N91-32943

**COUPLINGS**
Microwave blind mate coaxial connectors N91-32317
Two fault tolerant toggle-hook release [NASA-CASE-MSC-21671-1] N91-32498

**CRACK PROPAGATION**
Tensile and cyclic fatigue properties of SiC whisker-reinforced Al2O3 [DE91-015916] N91-32179
Advances in the design of toughened ceramics [DE91-016767] N91-32228
Fracture characterization for thermoinelasticity N91-32517
Load-line displacements for three-point bend J tests using bottom surface displacements [AD-A229634] N91-32518

**CRACK TIPS**
Analytical and numerical studies of fracture and fatigue in ceramic materials N91-32516

**CRASHES**
Aircraft accident report: Avianca, the Airline of Columbia, Boeing 707-321B, HK 2016, fuel exhaustion, Cove Neck, New York, January 25, 1990 [PB91-910404] N91-32087

**CRAY COMPUTERS**
Cray performance data from five benchmarks [NASA-TM-105200] N91-32806
Gigaflop performance on a CRAY-2: Multitasking a computational fluid dynamics application [NASA-TM-4305] N91-32841

**CREEP ANALYSIS**
Orr-Sherby-Dorn creep strengths of the refractory-metal alloys C-103, ASTAR-811C, W-5Re, and W-25Re [NASA-TM-105228] N91-32165

**CREEP PROPERTIES**
Orr-Sherby-Dorn creep strengths of the refractory-metal alloys C-103, ASTAR-811C, W-5Re, and W-25Re [NASA-TM-105228] N91-32165
Channel flow of a concentrated suspension [DE91-016649] N91-32453

**CREEP STRENGTH**
Orr-Sherby-Dorn creep strengths of the refractory-metal alloys C-103, ASTAR-811C, W-5Re, and W-25Re [NASA-TM-105228] N91-32165

**CROSS CORRELATION**
Optoelectronic associative memory [NASA-CASE-NPO-18278-1-CU] N91-32925

**CROSS FLOW**
Materials qualification technology for ceramic cross-flow filters [DE91-017715] N91-32232

**CROSSTALK**
Integrated filter and detector array for spectral imaging [NASA-CASE-NPO-18317-1-CU] N91-32926

**CRYOGENIC COOLING**
Cryogenic cooling of x ray crystals using porous matrix [DE91-017322] N91-32982

**CRYOGENIC EQUIPMENT**
The NASA cryogenic fluid management technology program plan [NASA-TM-105256] N91-32161

**CRYOGENIC FLUID STORAGE**
The NASA cryogenic fluid management technology program plan [NASA-TM-105256] N91-32161
Regenerative fuel cell architectures for lunar surface power N91-32560

**CRYOGENIC FLUIDS**
The NASA cryogenic fluid management technology program plan [NASA-TM-105256] N91-32161

**CRYOGENIC TEMPERATURE**
Optimization of CMOS technology and design for deep cryogenic analog circuits N91-32296

**CRYOGENICS**
The NASA cryogenic fluid management technology program plan [NASA-TM-105256] N91-32161
Cryogenic Orbital Nitrogen Experiment (CONE): Phase A/B design study [NASA-CR-187230] N91-32166
Cryogenic cooling of x ray crystals using porous matrix [DE91-017322] N91-32982

**CRYSTAL DEFECTS**
Electronic transport properties in copper oxides [DE91-018182] N91-32213
Flux pinning by planar defects in single crystal YBa2Cu3O(7-delta) [DE91-016525] N91-32968
Mechanisms of defect production and atomic mixing in high energy displacement cascades: A molecular dynamics study [DE91-017082] N91-32979
Application of a thermal spike model to experimental ion-induced grain growth data [DE91-017320] N91-32981

**CRYSTAL GROWTH**
Laboratory and field studies of stratospheric aerosols: Phase changes under high supersaturation N91-32533
Optical diagnostics of mercuric iodide crystal growth [DE91-017396] N91-32983

**CRYSTAL LATTICES**
The effects of platinum on nickel electrodes in the nickel hydrogen cell N91-32554

**CRYSTAL OSCILLATORS**
Qualification status of hybrid crystal oscillators style OTO 16S for space application N91-32322

**CRYSTAL RECTIFIERS**
Space silicon diodes: A survey of available technologies and related manufacturing and reliability aspects N91-32320

**CRYSTAL STRUCTURE**
Multiheteromacrocycles that complex metal ions [DE91-016292] N91-32205
The new metals and alloys compilation, a powerful materials analysis tool [DE91-016199] N91-32208
Electronic transport properties in copper oxides [DE91-018182] N91-32213
Ordering energy of B2 alloys calculated in the frozen potential and Harris approximations [DE91-017228] N91-32220
Laser performance and optical properties of LiSrGaF6:Cr(3+) [DE91-016555] N91-32481
On charging of snow particles in blizzard N91-32724
Flux pinning by planar defects in single crystal YBa2Cu3O(7-delta) [DE91-016525] N91-32968
Magnetic relaxation of the organic superconductor kappa-(BEDT-TTF)2Cu(N(CN)2)Br [DE91-016528] N91-32969
Evidence for cation disorder in in-situ grown YBaCuO superconducting films [DE91-016760] N91-32971
Application of a thermal spike model to experimental ion-induced grain growth data [DE91-017320] N91-32981
Anisotropy in the a-b plane of normal and superconducting YBa2Cu3O(x) [DE91-017997] N91-32989

**CRYSTALLINITY**
Dynamics of surface melting [DE91-016344] N91-32206
Ion implantation effects in crystalline quartz [DE91-016192] N91-32977

**CRYSTALS**
Theoretical modelling of AFM for bimetallic tip-substrate interactions [NASA-TM-105280] N91-32215
Computer simulation studies of high energy collision cascades [DE91-016225] N91-32903
Scaling behavior of the fluctuations in magnetization and conductivity of untwinned YBa2Cu3O(7-delta) [DE91-016524] N91-32967
A simple sagittal focusing crystal which utilizes a bimetallic strip [DE91-017324] N91-32975
Cryogenic cooling of x ray crystals using porous matrix [DE91-017322] N91-32982

**CUES**
Efficient packing of patterns in sparse distributed memory by selective weighting of input bits
[NASA-CR-188890] N91-32802
**CUMULONIMBUS CLOUDS**
Thunderstorm monitoring and lightning warning, operational applications of the Safir system N91-32619
The physics of the oscillating lightning N91-32696
**CUMULUS CLOUDS**
Airborne observations of electric fields around growing and decaying cumulus clouds N91-32616
Beta measurements N91-32681
**CURING**
Composite-faced sandwich construction for primary spacecraft structures N91-32170
**CURRENT ALGEBRA**
Graph theory and the Virasoro master equation
[DE91-016432] N91-32866
**CURRENT DENSITY**
Modeling water content effects in polymer electrolyte fuel cells
[DE91-016027] N91-32573
FD-TD numerical simulation of an entire lightning strike on the C160 aircraft N91-32648
Lightning induced currents in aircraft wiring using low level injection techniques N91-32694
Intense ion beam diagnostics for light ion inertial fusion experiments on PBFA 2
[DE91-017449] N91-32942
Single vortex motion and elementary pinning force in SNIS Josephson junctions
[DE91-016160] N91-32963
Magnetically measured irreversibility temperatures in superconducting oxides and alloys
[DE91-016895] N91-32972
**CURRENT DISTRIBUTION**
Some stable reconstruction algorithms for electrical impedance tomography
[DE91-016569] N91-32473
I-BIEM calculations of the frequency dispersion and AC current distribution at disk and ring-disk electrodes N91-32559
**CUTTING**
Laser processing in power plants
[DE91-527088] N91-32488
Nozzle fabrication technique
[NASA-CASE-MSC-21299-2] N91-32508
**CYBERNETICS**
Cognitive cybernetics and human communication: The regulatory effects of prior knowledge N91-32771
**CYCLOGENESIS**
Potential vorticity index N91-32672
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688
**CYCLONES**
Synoptic/planetary-scale interactions and blocking over the North Atlantic Ocean N91-32692
**CYCLOTRON RADIATION**
Calibration source for electron cyclotron emission measurements
[NIFS-19] N91-32913
**CYCLOTRON RESONANCE**
Advanced fusion diagnostics
[DE91-017412] N91-32941

## D

**DAMAGE**
Ion implantation effects in crystalline quartz
[DE91-016192] N91-32977
**DAMAGE ASSESSMENT**
Materials and processes laboratory composite materials characterization task, part 1. Damage tolerance
[NASA-TM-103553] N91-32185
Investigations into the damage for various types of unprotected carbon fibre composites with a variety of lightning arc attachments N91-32606
Evaluation of the damages caused by lightning current flowing through bearings N91-32632
A new approach to equipment testing N91-32639
Damage to metallic samples produced by measured lightning currents N91-32640
The new Section 23 of DO160C/ED14C lightning testing of externally mounted electrical equipment N91-32716
**DAMPING**
Acoustic damping of honeycomb-construction plates by pressure-sensitive adhesives
[NPL-DES-107] N91-32872
**DARK MATTER**
Testing the big bang: Light elements, neutrinos, dark matter, and large-scale structure
[DE91-017379] N91-33040
**DATA ACQUISITION**
Communications needs of the future air-ground interface N91-32125
Report on the photogrammetric determination of the shape of a 10m diameter microwave antenna
[NPL-MOM-103] N91-32248
The Telecommunications and Data Acquisition Report
[NASA-CR-188813] N91-32250
AMPR/SSMI data comparisons N91-32665
Saving all the bits
[NASA-CR-188879] N91-32817
Design of the Digital Sky Survey DA and online system: A case history in the use of computer aided tools for data acquisition system design
[DE91-016469] N91-33032
**DATA BASE MANAGEMENT SYSTEMS**
An overview of the NASA electronic components information management system N91-32369
Component field failure data base N91-32380
WetNet operations N91-32668
Implementation of the FAA research and development electromagnetic database N91-32715
Historical sunshine and cloud data in the United States
[DE91-016825] N91-32741
Environment, Safety and Health Thesaurus/Dictionary
[DE91-013428] N91-33012
**DATA BASES**
Determination of aerodynamic characteristics from ATTAS flight data gathering for ground-based simulator
[DLR-FB-91-15] N91-32076
Total dose characterization of new components for the ESA radiation effects database N91-32362
Results and considerations on failure investigations of components used for space equipment N91-32365
An overview of the NASA electronic components information management system N91-32369
Space flight components database N91-32377
Component field failure data base N91-32380
A plan of NASDA's parts database in the reliability information system N91-32381
Report of the expert group on global baseline datasets
[WCDP-11] N91-32598
Implementation of the FAA research and development electromagnetic database N91-32715
Historical sunshine and cloud data in the United States
[DE91-016825] N91-32741
Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography
[PB91-173351] N91-32755
Advanced software development workstation project ACCESS user's guide
[NASA-CR-188823] N91-32829
Identification of essential success factors for an electronic master publication library
[AD-A229624] N91-33004
Japan-US Liaison Group on Joint Databases Development
[PB91-214056] N91-33006
**DATA COMPRESSION**
Data compression for full motion video transmission
[NASA-TM-105239] N91-32247
**DATA LINKS**
Automatic Dependent Surveillance (ADS) Program summary N91-32094
Automatic Dependent Surveillance (ADS) development in Canada N91-32104
ADS communications: A cornerstone N91-32105
Satellite data link research and development program in Japan N91-32108
SITA satellite air communications implementation N91-32113
ADS integration into the flight management computer N91-32114
Use of ISO protocols in the ADS environment N91-32115
Near-term satellite-based oceanic air traffic control: Ground system description N91-32116
Impact of automation and data link enhancements on oceanic air traffic control N91-32117
US oceanic air traffic control: Past, present, and future N91-32118
Preliminary evaluation of ADS/radar correlation N91-32119
Operational oceanic air traffic control using satellite data link: Initial implementation N91-32121
Flight operations and air traffic management integration N91-32122
Communications needs of the future air-ground interface N91-32125
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
Ground automation processing of near-term oceanic ATC data link messages N91-32127
Evaluation of oceanic flight deck workload and error reductions through the use of data communications N91-32128
Propagation limitations for transionospheric systems from 10 to 300 GHz N91-32243
Satellite data link validation test plan
[DOT/FAA/CT-TN91/6] N91-32282
Millimeter wavelength communications applications for the SEI
[NASA-TM-105275] N91-32287
Selection strategy and reliability assessment for SILEX-communication laser diodes N91-32306
Coping with data from Space Station Freedom
[NASA-CR-188885] N91-33005
**DATA MANAGEMENT**
WetNet operations N91-32668
Interactive access and management for four-dimensional environmental data sets using McIDAS N91-32670
Coping with data from Space Station Freedom
[NASA-CR-188885] N91-33005
Japan-US Liaison Group on Joint Databases Development
[PB91-214056] N91-33006
UV-optical from space N91-33021
**DATA PROCESSING**
Delta VLBI data performance in the Galileo spacecraft Earth flyby of December 1990 N91-32274
Satellite data link validation test plan
[DOT/FAA/CT-TN91/6] N91-32282
NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review
[NASA-CP-3126] N91-32660
Advanced visualization techniques N91-32669
Computing and data processing N91-33028
**DATA REDUCTION**
Performance of a benchmark implementation of the Van Slyke and Wets algorithm for stochastic programs on the Alliant FX/8
[DE91-016515] N91-32833
**DATA SAMPLING**
Methods for the automatic de-aliasing of the Doppler velocity of a weather radar
[DLR-FB-91-08] N91-32249
Design and status of the RF-digitizer integrated circuit N91-32262
**DATA STORAGE**
A solid state mass memory for space applications: Technological and system aspects N91-32329
Component field failure data base N91-32380
Analog hardware for learning neural networks
[NASA-CASE-NPO-17664-1-CU] N91-32852
**DATA STRUCTURES**
SPARSKIT: A basic tool kit for sparse matrix computations
[NASA-CR-185876] N91-32865
**DATA SYSTEMS**
Stochastic availability analysis of operational data systems in the Deep Space Network N91-32278
Coping with data from Space Station Freedom
[NASA-CR-188885] N91-33005
Design of the Digital Sky Survey DA and online system: A case history in the use of computer aided tools for data acquisition system design
[DE91-016469] N91-33032
**DATA TRANSMISSION**
Aeronautical mobile satellite services ESA-PRODAT/SITA AIRCOM service trials programme N91-32106
Evaluation of oceanic flight deck workload and error reductions through the use of data communications N91-32128
Wide band systems N91-32242
Propagation limitations for transionospheric systems from 10 to 300 GHz N91-32243
Data compression for full motion video transmission
[NASA-TM-105239] N91-32247
Millimeter wavelength communications applications for the SEI
[NASA-TM-105275] N91-32287
Selection strategy and reliability assessment for SILEX-communication laser diodes N91-32306
**DECISION MAKING**
Feasibility study on the use of groupware support for NASA source evaluation boards
[NASA-CR-188832] N91-32824
Evaluation of knowledge-based system development tools
[DE91-017241] N91-32860
**DECODING**
Multi-dimensional modulation codes for fading channel
[NASA-CR-188959] N91-32288

**DECOUPLING**
Two fault tolerant toggle-hook release
[NASA-CASE-MSC-21671-1] N91-32498
**DEEP SPACE**
The Advanced Receiver II telemetry test results at Goldstone N91-32260
Initial pointing calibrations for the DSS 13 34-meter beam-waveguide antenna N91-32267
Modeling and simulations of the DSS 13 antenna control system N91-32268
Efficiency calibration of the DSS 13 34-meter diameter beam waveguide antenna at 8.45 and 32 GHz N91-32271
A carrier-arraying demonstration at Goldstone for receiving Pioneer 11 signals N91-32273
**DEEP SPACE NETWORK**
The Telecommunications and Data Acquisition Report [NASA-CR-188813] N91-32250
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
Testing interconnected VLSI circuits in the Big Viterbi Decoder N91-32265
Frame error rate of the NASA concatenated coding system N91-32266
DSS 13 phase 2 pedestal room microwave layout N91-32272
Delta VLBI data performance in the Galileo spacecraft Earth flyby of December 1990 N91-32274
JPL 1990-3: A 5-nrad extragalactic source catalog based on combined radio interferometric observations N91-32276
Modeling preparation costs for space missions by using major cost drivers N91-32279
**DEFECTS**
Theoretical modelling of AFM for bimetallic tip-substrate interactions
[NASA-TM-105280] N91-32215
Radiation-induced attenuation of high-OH optical fibers after hydrogen treatment in the presence of ionizing radiation
[DE91-016093] N91-32921
**DEFENSE PROGRAM**
Military robotics technologies at Sandia National Laboratories
[DE91-016113] N91-32858
Defense Logistic Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 1: Agency-wide plan IRM summary information: Agency
[PB91-204529] N91-33007
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 2: Individual organizational IRM plans: Organizations
[PB91-204537] N91-33008
**DEFLECTORS**
Quantum well, beam deflecting surface emitting lasers
[NASA-CASE-NPO-18243-1-CU] N91-32489
**DEFORMATION**
Interlaminar deformations on the cylindrical surface of a hole in laminated composites: An experimental study N91-32172
Tensile and cyclic fatigue properties of SiC whisker-reinforced Al2O3
[DE91-015916] N91-32179
Effect of prior mechanical deformation on hydrogen transport through 13 percent chromium martensitic stainless steel
[NPL-DMM(A)-14] N91-32202
Zonal deformable mirror for laser wavefront control
[DE91-017085] N91-32483
Finite element implementation of state variable-based viscoplasticity models
[NASA-CR-187212] N91-32523
**DEGASSING**
Helium isotopic constraints on terrestrial degassing and the transcrustal transport of mantle methane
[PB91-206458] N91-32594
**DEHYDROGENATION**
New directions for the catalytic conversion of methane
[PB91-206417] N91-32191
**DEICERS**
Electromagnetic emissions from an electro-impulse deicing system in a composite wing equipped with lightning protection
[DOT/FAA/CT-TN90/32] N91-32284
**DELAMINATING**
Delaminations in composite plates under transverse static or impact loads N91-32183
**DELTA WINGS**
Rarefied gas numerical wind tunnel 6: Delta wing N91-32039
**DENSIFICATION**
Reaction sintering of ZnO-Al2O3
[DE91-016254] N91-32210
**DENSITY (MASS/VOLUME)**
Laser-based diagnostics for density, temperature, velocity, and dissociation fraction in high temperature hydrogen flows
[DE91-016323] N91-32480
**DENSITY DISTRIBUTION**
FD-TD numerical simulation of an entire lightning strike on the C160 aircraft N91-32648
Atmospheres of comets: Gas dynamic models and inference of kinematic parameters N91-33036
**DENTISTRY**
Medical evaluations on the KC-135 1990 flight report summary
[NASA-TM-104740] N91-32776
Health maintenance facility: Dental equipment requirements N91-32777
Dental equipment test during zero-gravity flight N91-32778
**DEOXYRIBONUCLEIC ACID**
Photobiological investigations on spores of Streptomyces griseus
[DLR-FB-91-14] N91-32748
**DEPLOYMENT**
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals N91-32785
Minor surgery in microgravity N91-32786
**DEPOLARIZATION**
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537
**DEPOSITION**
Lubrication with sputtered MoS2 films: Principles, operation, limitations
[NASA-TM-105292] N91-32216
Development of a spray-forming process for steel
[DE91-015812] N91-32218
Integrated filter and detector array for spectral imaging
[NASA-CASE-NPO-18317-1-CU] N91-32926
**DERMATITIS**
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting
[DE91-017545] N91-32758
**DESERTS**
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada
[NASA-CR-183493] N91-32591
**DESIGN ANALYSIS**
Application of AI to engineering problems N91-32033
Application of 3-D Navier-Stokes computation to turbine vane design N91-32069
On the maximum range of flying wings
[AD-A229487] N91-32130
Control design variable linking for optimization of structural/control systems N91-32144
Adhesive bonding handbook for advanced structural materials
[ESA-PSS-03-210-ISSUE-1] N91-32234
Design and status of the RF-digitizer integrated circuit N91-32262
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 2: Tests on the antenna N91-32270
Model calculations for a pushbroom stereo camera: The case of the Mars 94 High Resolution Stereo Camera (HRSC)
[DLR-FB-90-57] N91-32468
Lightning protection for shuttle propulsion elements N91-32630
A transportable 50 kA dual mode lightning simulator N91-32633
Designs for surge immunity in critical electronic facilities N91-32635
An assessment of tailoring of lightning protection design requirements for a composite wing structure on a metallic aircraft N91-32641
Lightning protection design and testing of an all composite wet wing for the Egrett N91-32642
Design of lightning protection for a full-authority digital engine control N91-32717
Certification of lightning protection for a full-authority digital engine control N91-32718
LT-23: The feedback vibrating capacitor fieldmeter N91-32722
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) N91-32787
Reliability and cost: A sensitivity analysis
[NASA-TM-105293] N91-33014
**DESORPTION**
The effect of chemical additives on the synthesis of ethanol
[DE91-016586] N91-32192
Photon stimulated desorption from aluminum and stainless steel
[DE91-017007] N91-32211
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium
[DE91-016161] N91-32964
**DESTRUCTIVE TESTS**
The merits of an independent pre-cap inspection N91-32378
Physical and chemical analysis of a Ni/H2 cell N91-32555
**DETECTION**
Interim explosives detection alternatives
[DE91-016188] N91-32089
Aerosol sensing from balloons using photopolarimetry N91-32538
An analog retina model for detecting moving objects against a moving background
[DE91-017428] N91-32544
**DETONATION**
Effect of initial conditions on combustion generated loads
[DE91-016646] N91-32194
**DEUTERIUM**
Inertial Confinement Fusion, Volume 1, Number 2
[DE91-017920] N91-32951
**DEUTERIUM PLASMA**
Initial operational experience after installation of the D3-D radiation shield
[DE91-017765] N91-32949
**DIAMINES**
Addition polyimides with enhanced processability
[NASA-CASE-LEW-15043-1] N91-32230
**DIAMONDS**
High pressure Moessbauer spectroscopy in diamond anvil cells
[DE91-016018] N91-32961
**DICHROISM**
X ray dichroism and Faraday effect studies in ordered and disordered Fe3Pt
[DE91-017305] N91-32974
**DICTIONARIES**
ICBM abbreviations and acronyms (2nd edition)
[PB91-193375] N91-33011
Environment, Safety and Health Thesaurus/Dictionary
[DE91-013428] N91-33012
**DIELECTRICS**
Performance of a 10 kV, 625 kA, 85 kJ energy discharge module utilizing a solid dielectric switch
[DE91-017432] N91-32409
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy
[DE91-016571] N91-32917
**DIES**
Design, development, and qualification of special super N-channel MOSFET die for space applications N91-32297
An evaluation programme for the capability approval of GaAs MMICs N91-32303
**DIESEL FUELS**
Effects of oxygen enrichment and fuel emulsification on diesel engine performance and emissions
[DE91-016520] N91-32506
**DIFFERENTIAL EQUATIONS**
An r-matrix approach to nonstandard classes of integrable equations
[MATHS-REPT-A-149] N91-32861
**DIFFRACTION**
Analysis of polarization properties of shallow metallic gratings by an extended Rayleigh-Fano theory
[DE91-016982] N91-32835
Hadronic photons and collider diffractive physics
[DE91-016514] N91-32888
**DIFFRACTION PATTERNS**
Three dimensional moire pattern alignment
[NASA-CASE-MSC-21416-1] N91-32922
**DIFFUSION**
Radiation-induced attenuation of high-OH optical fibers after hydrogen treatment in the presence of ionizing radiation
[DE91-016093] N91-32921
**DIFFUSION LENGTH**
Liquid and solid Ga and Bi studies with a variable energy positron beam
[DE91-016910] N91-32889
**DIFFUSION WELDING**
Effect of thermal exposure, forming, and welding on high-temperature, dispersion-strengthened aluminum alloy: Al-8Fe-1V-2Si
[NASA-CR-187575] N91-32200
**DIGITAL DATA**
Global lightning studies N91-32667

**DIGITAL ELECTRONICS**
Digital ASIC design for space applications N91-32300
**DIGITAL FILTERS**
Performance of a high T(sub c) superconducting ultra-low loss microwave stripline filter N91-32255
Multilevel filtering elliptic preconditioners [NASA-CR-188851] N91-32845
**DIGITAL RADAR SYSTEMS**
HF systems operating beneath the ionosphere N91-32244
**DIGITAL SIMULATION**
Numerical study of partitioned turbulence [ONERA-RSF-20/3419-AY-124A] N91-32437
Numerical simulation of turbulent convection over wavy surfaces [DLR-FB-91-12] N91-32439
Parametric rectification of thematic mapper raw data [DLR-FB-90-55] N91-32543
FD-TD numerical simulation of an entire lightning strike on the C160 aircraft N91-32648
**DIGITAL SYSTEMS**
Digitized voice trials N91-32103
Wide band systems N91-32242
Channel assignments and array gain bounds for the Ka-band array feed compensation system N91-32263
Testing interconnected VLSI circuits in the Big Viterbi Decoder N91-32265
Laboratory test results of solid state video cameras [DE91-016189] N91-32399
Lightning protection of full authority digital electronic systems N91-32643
Design of lightning protection for a full-authority digital engine control N91-32717
The formal verification of generic interpreters [NASA-CR-4403] N91-32853
**DIGITAL TECHNIQUES**
Design and status of the RF-digitizer integrated circuit N91-32262
**DILUTION**
Further development of IDGS: Isotope dilution gamma-ray spectrometry [DE91-016315] N91-32936
**DIMENSIONAL ANALYSIS**
Gaussian elimination methods for calculating classical periodic trajectories in two dimensions [DE91-017600] N91-32869
**DIMENSIONAL MEASUREMENT**
Measurements of some parameters of thermal sparks with respect to their ability to ignite aviation fuel/air mixtures N91-32705
**DIRECTION FINDING**
Extension of and improvements to the ERDC low frequency magnetic direction finding system N91-32708
An iterative method for obtaining the optimum lightning location on a spherical surface N91-32709
Comparison of lightning location data and polarisation radar observations of clouds N91-32710
The spatial variations of lightning during small Florida thunderstorms N91-32711
Weak positive cloud-to-ground flashes in Northeastern Colorado N91-32712
**DISCONNECT DEVICES**
Two fault tolerant toggle-hook release [NASA-CASE-MSC-21671-1] N91-32498
**DISCRETE FUNCTIONS**
Upwind methods and multidimensional splittings for the Euler equations N91-32429
Fluctuation splitting schemes for the 2D Euler equations N91-32430
Spectral element methods for the unsteady Navier-Stokes equations N91-32432
**DISKS**
Numerical simulation of a laser welding process [DE91-016454] N91-32500
**DISORIENTATION**
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory N91-32761
**DISPLACEMENT MEASUREMENT**
Load-line displacements for three-point bend J tests using bottom surface displacements [AD-A229634] N91-32518
**DISPLAY DEVICES**
GOOSE: A Generalized Object-Oriented Simulation Environment [DE91-016771] N91-32842
**DISSIPATION**
Power and energy dissipation in subsequent return strokes as predicted by a new return stroke model N91-32657
**DISSOCIATION**
The Navy/NASA Engine Program (NNEP89): Interfacing the program for the calculation of complex Chemical Equilibrium Compositions (CEC) [NASA-CR-187208] N91-32141
Laser-based diagnostics for density, temperature, velocity, and dissociation fraction in high temperature hydrogen flows [DE91-016323] N91-32480
**DISSOLVING**
The role of anodic dissolution in the stress corrosion cracking of Al-Li-Cu alloy 2090 [DE91-016403] N91-32219
Leaching behavior of microtektite glass compositions in sea water and the effect of precipitation on glass leaching [NASA-TM-105106] N91-32225
**DISTANCE**
A new approach to the determination of the striking distance from the lightning channel photos N91-32698
**DISTORTION**
Compressible flows with vortical disturbances around a cascade of airfoils N91-32083
Distortion free projection lithography [DE91-016570] N91-32916
**DISTRIBUTED PARAMETER SYSTEMS**
Recognition of simple visual images using a sparse distributed memory: Some implementations and experiments [NASA-CR-186616] N91-32797
**DISTRIBUTED PROCESSING**
The Cortex Transform as an image preprocessor for sparse distributed memory: An initial study [NASA-CR-187436] N91-32798
Efficient packing of patterns in sparse distributed memory by selective weighting of input bits [NASA-CR-188890] N91-32802
Programming in a proposed 9X distributed Ada [NASA-CR-188831] N91-32825
**DISTRIBUTION (PROPERTY)**
Total dose effects in MOS systems: Influence of the initial hydrogen distribution N91-32338
**DISTRIBUTION FUNCTIONS**
Electron distribution functions in electric field environments N91-32726
A new variational formulation of kinetic plasma theory and the application of moving finite elements [DE91-016072] N91-32938
**DIVERTERS**
Geometric dependence of the scaling law on the energy confinement time in H-mode discharges [NIFS-93] N91-32931
L to H mode transitions and associated phenomena in divertor tokamaks [DE91-017074] N91-32940
**DIVIDERS**
Design and evaluation of a GaAs MMIC X-band active RC quadrature power divider [FEL-91-A076] N91-32396
**DMSP SATELLITES**
Global lightning studies N91-32667
**DOPED CRYSTALS**
Laser performance and optical properties of LiSrGaF6:Cr(3+) [DE91-016555] N91-32481
**DOPPLER EFFECT**
Methods for the automatic de-aliasing of the Doppler velocity of a weather radar [DLR-FB-91-08] N91-32249
**DOPPLER NAVIGATION**
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251
**DOPPLER RADAR**
Atmospheric aerosol and Doppler lidar studies N91-32666
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686
**DOSIMETERS**
Comparison of factors given in ICRU report 23 and IAEA TRS 277 for converting from exposure/air kerma to absorbed dose to water for medium energy x rays [NPL-RSA(EXT)-15] N91-32147
Temperature compensation of PMOS dosimeters N91-32336
Advances in SEM beam micro-irradiation N91-32360
Laser heated calcium sulfate TLD plates: Application to radiation mapping N91-32364
Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] N91-32756
Intercomparison of standards of absorbed dose between the USSR and the UK [NPL-RSA(EXT)-17] N91-32874
Benchmark field study of deep neutron penetration [DE91-015677] N91-32886
Fast neutron dosimetry [DE91-016907] N91-32894
**DOWNLINKING**
Ground automation processing of near-term oceanic ATC data link messages N91-32127
**DOWNWASH**
Analysis of rotorwash effects in helicopter mishaps [DOT/FAA/RD-90/17] N91-32086
**DROP TESTS**
Materials and processes laboratory composite materials characterization task, part 1. Damage tolerance [NASA-TM-103553] N91-32185
**DROPS (LIQUIDS)**
The internal caustic structure of illuminated liquid droplets [NASA-CR-187194] N91-32474
**DRUGS**
Prevention and treatment of motion sickness: Non-pharmacological therapy N91-32767
Assessment of drug effectiveness N91-32768
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals N91-32785
**DUCTED FLOW**
Numerical treatment of laminar flow in curved rectangular channels with entrance region N91-32053
Developing laminar flow and heat transfer in orthogonally rotating square ducts N91-32054
Numerical simulation of thermal convection in a rectangular duct flow N91-32062
Parabolized Navier-Stokes methods for ducted flow systems N91-32434
**DUMMIES**
Evaluation of cardiopulmonary resuscitation techniques in microgravity N91-32789
**DUST**
Charge control experiments on a CH-53E helicopter in a dusty environment N91-32625
**DUST STORMS**
Additions to Mars Global Reference Atmospheric Model (Mars-GRAM) [NASA-CR-188924] N91-33045
**DYE LASERS**
High-intensity photoionization of H2 [DE91-017087] N91-32885
**DYNAMIC CONTROL**
Dynamics modeling and control of a flexible robot arm N91-32495
**DYNAMIC MODELS**
A two-dimensional dynamic mix model in free Lagrange hydrodynamics [DE91-017661] N91-32467
GOOSE: A Generalized Object-Oriented Simulation Environment [DE91-016771] N91-32842
**DYNAMIC PRESSURE**
Optimal control problems with switching points [NASA-CR-4393] N91-32155
**DYNAMIC RESPONSE**
On the nonlinear response of minor atmospheric species to linear gravity waves N91-32593
**DYNAMIC STABILITY**
Control design variable linking for optimization of structural/control systems N91-32144
**DYNAMIC STRUCTURAL ANALYSIS**
Time-frequency domain analysis of helicopter transmission vibration [ARL-PROP-R-180] N91-32146
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525

## E

**EARTH ATMOSPHERE**
NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review [NASA-CP-3126] N91-32660
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687
**EARTH CRUST**
Helium isotopic constraints on terrestrial degassing and the transcrustal transport of mantle methane [PB91-206458] N91-32594
**EARTH OBSERVATIONS (FROM SPACE)**
NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review [NASA-CP-3126] N91-32660
**EARTH OBSERVING SYSTEM (EOS)**
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686
**EARTH ORBITAL ENVIRONMENTS**
Single event effects by protons on low Earth orbits: A problem for European manned space missions N91-32349

**EARTH ORBITS**
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251
**EARTH RESOURCES**
Nature and technology: Energy technology, mankind, and nature in the 21st century
[DLR-MITT-91-05] N91-32581
**EARTHQUAKES**
Earth sciences report, 1989 - 1990
[DE91-017132] N91-33053
**ECONOMIC ANALYSIS**
Satellite surveillance and communications airline benefits: The telephone myth N91-32124
Europe 1993: The single European market and R and D policy at Krupp N91-32995
Europe 1993: Challenge and opportunity for distribution logistics N91-32998
**ECONOMIC DEVELOPMENT**
Krupp Technical Reports, number 2, December 1990 (English version)
[ISSN-0930-9276] N91-32994
Know-how for Europe N91-32997
Europe 1993: Challenge and opportunity for distribution logistics N91-32998
**ECONOMIC IMPACT**
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
**ECONOMICS**
Management of acute and chronic motion sickness N91-32769
**ECOSYSTEMS**
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
**EDDY VISCOSITY**
Spectral transfer analysis for subgrid-scale modelling N91-32438
**EDUCATION**
Pressure safety training
[DE91-015717] N91-32238
Energy and technology review
[DE91-016873] N91-32572
Study on observational systems: A review of meteorological and oceanographic education in observational techniques and the relationship to national facilities and needs
[PB91-198168] N91-32739
Teaching engineers to be technical leaders
[DE91-016117] N91-33002
Benefits to the nation from astronomy and astrophysics N91-33030
**EIGENVALUES**
Ordering energy of B2 alloys calculated in the frozen potential and Harris approximations
[DE91-017228] N91-32220
An implementation of the look-ahead Lanczos algorithm for non-Hermitian matrices
[NASA-CR-188889] N91-32820
Parallel implementation of a nonsymmetric tridiagonal eigensolver
[DE91-016773] N91-32834
**EIGENVECTORS**
Parallel implementation of a nonsymmetric tridiagonal eigensolver
[DE91-016773] N91-32834
**ELASTIC BODIES**
Nonlinear dynamic analysis of flexible multibody systems
[NASA-CR-187597] N91-32519
**ELECTRIC ARCS**
The new Section 23 of DO160C/ED14C lightning testing of externally mounted electrical equipment N91-32716
Corrosion and arc erosion in MHD channels
[DE91-016829] N91-32939
**ELECTRIC BATTERIES**
Modeling and analysis of spacecraft battery charger systems N91-32411
Space Electrochemical Research and Technology
[NASA-CP-3125] N91-32549
Sodium-metal chloride battery research at JPL N91-32566
**ELECTRIC CHARGE**
The detection of the electric field vertical distribution underneath thundercloud: Principle and applications N91-32653
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656
On charging of snow particles in blizzard N91-32724
A simulated lightning effects test facility for testing live and inert missiles and components N91-32725
Analogous behavior in the quantum hall effect, anyon superconductivity, and the standard model
[DE91-016609] N91-32970
**ELECTRIC COILS**
Stress states in wound capacitors
[DE91-016402] N91-32400
**ELECTRIC CONDUCTORS**
The repair and modification of printed-circuit board assemblies for space use
[ESA-PSS-01-728-ISSUE-2] N91-32422
Discussions on a long gap discharge to an EHV transmission tower by a rocket triggered lightning experiment N91-32654
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656
**ELECTRIC CONNECTORS**
Testing interconnected VLSI circuits in the Big Viterbi Decoder N91-32265
Microwave blind mate coaxial connectors N91-32317
Mating and unmating of multi-pin connectors under vacuum N91-32319
The crimping of high-reliability electrical connections
[ESA-PSS-01-726-ISSUE-2] N91-32421
The repair and modification of printed-circuit board assemblies for space use
[ESA-PSS-01-728-ISSUE-2] N91-32422
**ELECTRIC CONTACTS**
Assessment of p-metallisations for high power GaAs laser diodes N91-32316
The crimping of high-reliability electrical connections
[ESA-PSS-01-726-ISSUE-2] N91-32421
**ELECTRIC CORONA**
Evidence for SF4 and SF2 formation in SF6 corona discharges
[DE91-015927] N91-32285
Optimal parameters of leader development in lightning N91-32723
**ELECTRIC CURRENT**
Current wave-form observed during lightning strikes on aircraft N91-32603
Lightning current rate of rise in the new lightning flash model for the space shuttle program N91-32604
Characteristics of winter lightning currents struck an isolated tower N91-32607
Damage to metallic samples produced by measured lightning currents N91-32640
Correlation between some current parameters and optical radiation generated by 280 mm long laboratory sparks N91-32655
Charge transfer during individual collisions in ice growing by riming N91-32727
Single vortex motion and elementary pinning force in SNIS Josephson junctions
[DE91-016160] N91-32963
Critical currents in melt-textured YBa2Cu3O(x)
[DE91-016523] N91-32966
Magnetically measured irreversibility temperatures in superconducting oxides and alloys
[DE91-016895] N91-32972
Critical currents in sputtered YBCO films
[DE91-017976] N91-32987
**ELECTRIC DISCHARGES**
Evidence for SF4 and SF2 formation in SF6 corona discharges
[DE91-015927] N91-32285
Low-cost 3 kV, triggered, stripline, surface-discharge switch
[DE91-016641] N91-32403
Performance of a 10 kV, 625 kA, 85 kJ energy discharge module utilizing a solid dielectric switch
[DE91-017432] N91-32409
Performance of a dual anode nickel-hydrogen cell N91-32563
Sodium-metal chloride battery research at JPL N91-32566
Advances in Li-TiS2 cell technology N91-32567
A study of point discharge current observations in the thunderstorm environment at a tropical station during the year 1987 and 1988 N91-32721
A simulated lightning effects test facility for testing live and inert missiles and components N91-32725
Electron distribution functions in electric field environments N91-32726
Self-generated stochastic heating in an RF discharge
[DE91-017404] N91-32948
**ELECTRIC EQUIPMENT**
A statistical evaluation of EEE-parts procurement data from telecommunication satellites N91-32368
Certification of lightning protection for a full-authority digital engine control N91-32718
**ELECTRIC EQUIPMENT TESTS**
Mating and unmating of multi-pin connectors under vacuum N91-32319
**ELECTRIC FIELD STRENGTH**
Airborne observations of electric fields around growing and decaying cumulus clouds N91-32616
**ELECTRIC FIELDS**
The internal caustic structure of illuminated liquid droplets
[NASA-CR-187194] N91-32474
Lightning threat to aircraft: Do we know all we need to know? N91-32600
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601
Thunderstorm detection and warning system atmospheric potential monitor N91-32608
Electrical emissions of airplanes flying in electrified clouds and their effect on airplane measurements of cloud electric fields N91-32609
E and DE/DT waveshapes for narrow bipolar pulses in intracloud lightning N91-32610
First and subsequent return stroke properties of cloud-to-ground lightning N91-32614
Characteristics of return stroke electric fields produced by lightning flashes at distances of 1 to 15 kilometers N91-32615
Airborne observations of electric fields around growing and decaying cumulus clouds N91-32616
Charge control experiments on a CH-53E helicopter in a dusty environment N91-32625
Characterization of vertical electric fields and associated voltages induced on a overhead power line from close artificially initiated lightning N91-32629
The electric field change caused by a ground flash with multiple channels N91-32647
Scale-model charge-transfer technique for measuring enhancement factors N91-32651
The electric field changes and UHF radiations caused by the triggered lightning in Japan N91-32652
The detection of the electric field vertical distribution underneath thundercloud: Principle and applications N91-32653
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656
Horizontal fields generated by return strokes N91-32658
Observations of lightning processes using VHF radio interferometry N91-32695
The physics of the oscillating lightning N91-32696
A system for mapping sources of VHF and electric field pulses from in-cloud lightning at KSC N91-32697
A new approach to the determination of the striking distance from the lightning channel photos N91-32698
The spatial variations of lightning during small Florida thunderstorms N91-32711
On error sources during airborne measurements of the ambient electric field N91-32719
A study of point discharge current observations in the thunderstorm environment at a tropical station during the year 1987 and 1988 N91-32721
LT-23: The feedback vibrating capacitor fieldmeter N91-32722
Optimal parameters of leader development in lightning N91-32723
On charging of snow particles in blizzard N91-32724
Electron distribution functions in electric field environments N91-32726
ELMy-H mode as limit cycle and chaotic oscillations in tokamak plasmas
[NIFS-96] N91-32932
An H-mode-like bifurcation in core plasma of stellarators
[NIFS-97] N91-32933
Excitation of nonlinear wake field in a plasma for particle acceleration
[DE91-017386] N91-32945
Edge electric field profiles of H-mode plasmas in JFT-2M tokamak
[NIFS-26] N91-32956
Development of the stellarator/heliotron research
[NIFS-84] N91-32957
**ELECTRIC GENERATORS**
A power beaming based infrastructure for space power
[DE91-017533] N91-32169
Evaluation of the damages caused by lightning current flowing through bearings N91-32632
**ELECTRIC POTENTIAL**
Temperature compensation of PMOS dosimeters N91-32336
Thunderstorm detection and warning system atmospheric potential monitor N91-32608
Step voltage analysis for the catenoid lightning protection system N91-32623
Hardening communication ports for survival in electrical overstress environments N91-32624
Characterization of vertical electric fields and associated voltages induced on a overhead power line from close artificially initiated lightning N91-32629
The electromagnetic environment in CFC structures N91-32638

Circuit protection devices for transient suppression N91-32732
Voltages induced on a power distribution line by overhead cloud lightning N91-32734
High current pulse testing for ground rod integrity N91-32737

**ELECTRIC POWER**
The crimping of high-reliability electrical connections [ESA-PSS-01-726-ISSUE-2] N91-32421

**ELECTRIC POWER PLANTS**
Power system requirements and selection for the space exploration initiative [DE91-016707] N91-32150
Benefit/cost comparison for utility SMES applications [DE91-017425] N91-32408

**ELECTRIC POWER TRANSMISSION**
Benefit/cost comparison for utility SMES applications [DE91-017425] N91-32408
The electric field change caused by a ground flash with multiple channels N91-32647

**ELECTRIC PROPULSION**
Multimegawatt electric propulsion system design considerations [NASA-TM-105152] N91-32164
Performance enhancement using power beaming for electric propulsion Earth orbital transporters [DE91-017287] N91-32168

**ELECTRIC PULSES**
E and DE/DT waveshapes for narrow bipolar pulses in intracloud lightning N91-32610
Influence of configuration effects on multiple burst simulation testing N91-32631
A transportable 50 kA dual mode lightning simulator N91-32633
Simulation and measurement of melting effects on metal sheets caused by direct lightning strikes N91-32644

**ELECTRIC ROCKET ENGINES**
MPD thruster technology [NASA-TM-105242] N91-32162

**ELECTRIC SWITCHES**
Development and operation of a solid-state switch for thyratron replacement [DE91-016553] N91-32401
Low-cost 3 kV, triggered, stripline, surface-discharge switch [DE91-016641] N91-32403

**ELECTRIC WIRE**
The performance of cable braids and terminations to lightning induced transients N91-32611

**ELECTRICAL ENGINEERING**
Progress in submicron technologies N91-32394
Development of polymer alloys for electrical engineering applications N91-33000

**ELECTRICAL FAULTS**
Initial testing of a two-dimensional computer code for microwave-induced surface breakdown in air [DE91-015763] N91-32286
Withstanding voltage degradation of EEE components due to cavity pressure loss N91-32313

**ELECTRICAL GROUNDING**
Electromagnetic emissions from an electro-impulse deicing system in a composite wing equipped with lightning protection [DOT/FAA/CT-TN90/32] N91-32284
High current pulse testing for ground rod integrity N91-32737

**ELECTRICAL IMPEDANCE**
Some stable reconstruction algorithms for electrical impedance tomography [DE91-016569] N91-32473
Impedances of nickel electrodes cycled in various KOH concentrations N91-32557

**ELECTRICAL MEASUREMENT**
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601
Thunderstorm detection and warning system atmospheric potential monitor N91-32608
Electrical emissions of airplanes flying in electrified clouds and their effect on airplane measurements of cloud electric fields N91-32609
First and subsequent return stroke properties of cloud-to-ground lightning N91-32614
The electromagnetic environment in CFC structures N91-32638
Damage to metallic samples produced by measured lightning currents N91-32640
Simulation and measurement of melting effects on metal sheets caused by direct lightning strikes N91-32644
Scale-model charge-transfer technique for measuring enhancement factors N91-32651
The electric field changes and UHF radiations caused by the triggered lightning in Japan N91-32652
The detection of the electric field vertical distribution underneath thundercloud: Principle and applications N91-32653
On error sources during airborne measurements of the ambient electric field N91-32719
A study of point discharge current observations in the thunderstorm environment at a tropical station during the year 1987 and 1988 N91-32721
LT-23: The feedback vibrating capacitor fieldmeter N91-32722

**ELECTRICAL RESISTANCE**
A new approach to the reliability of electronic material systems N91-32310

**ELECTRICAL RESISTIVITY**
Measurement of interfacial area using four sensor probe in two phase flow [DE91-017415] N91-32466
Charge control experiments on a CH-53E helicopter in a dusty environment N91-32625
Experimental modelling of lightning interaction phenomena with a free potential conducting objects N91-32729
Anisotropy in the a-b plane of normal and superconducting YBa2Cu3O(x) [DE91-017997] N91-32989

**ELECTRIFICATION**
Charge control experiments on a CH-53E helicopter in a dusty environment N91-32625
Electrification in winter storms and the analysis of thunderstorm overflight N91-32678
On error sources during airborne measurements of the ambient electric field N91-32719

**ELECTROCARDIOGRAPHY**
The QT interval in lightning injury with implications for the cessation of metabolism hypothesis N91-32621

**ELECTROCATALYSTS**
Oxygen electrodes for rechargeable alkaline fuel cells, 3 N91-32561

**ELECTROCHEMICAL CORROSION**
The role of anodic dissolution in the stress corrosion cracking of Al-Li-Cu alloy 2090 [DE91-016403] N91-32219

**ELECTROCHEMISTRY**
Space Electrochemical Research and Technology [NASA-CP-3125] N91-32549

**ELECTRODE MATERIALS**
The effects of platinum on nickel electrodes in the nickel hydrogen cell N91-32554
Oxygen electrodes for rechargeable alkaline fuel cells, 3 N91-32561
Sodium-metal chloride battery research at JPL N91-32566
Advances in Li-TiS2 cell technology N91-32567

**ELECTRODEPOSITION**
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application [NASA-TM-103551] N91-32217
Monitoring interfacial dynamics by pulsed laser techniques [DE91-016950] N91-32485
Raman spectral observation of a new phase observed in nickel electrodes cycled to failure N91-32556

**ELECTRODES**
Monitoring interfacial dynamics by pulsed laser techniques [DE91-016950] N91-32485
Gas tungsten arc adaptive welding [DE91-017848] N91-32513
The effects of platinum on nickel electrodes in the nickel hydrogen cell N91-32554
Raman spectral observation of a new phase observed in nickel electrodes cycled to failure N91-32556
Impedances of nickel electrodes cycled in various KOH concentrations N91-32557
High energy efficiency and high power density proton exchange membrane fuel cells: Electrode kinetics and mass transport N91-32558
I-BIEM calculations of the frequency dispersion and AC current distribution at disk and ring-disk electrodes N91-32559
Some recent studies with the solid-ionomer electrochemical capacitor N91-32562
How to create ball lightning N91-32728
Ion clearing and photoelectron production in the 200 MeV SXLS ring [DE91-017156] N91-32907

**ELECTROHYDRODYNAMICS**
Laboratory and theoretical models of planetary-scale instabilities and waves N91-32675

**ELECTROLUMINESCENCE**
Displacement threshold energy in GaAs determined by electrical and optical investigations N91-32337

**ELECTROLYSIS**
Electrolytic production of oxygen from lunar resources N91-32550
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
Space water electrolysis: Space Station through advance missions N91-32553

**ELECTROLYTES**
Raman spectral observation of a new phase observed in nickel electrodes cycled to failure N91-32556
Multiple cell common pressure vessel nickel hydrogen battery N91-32564
Advances in Li-TiS2 cell technology N91-32567
Impact of fundamental technical improvements to natural gas fuel cells [PB91-206615] N91-32570

**ELECTROLYTIC CELLS**
Space water electrolysis: Space Station through advance missions N91-32553
Modeling water content effects in polymer electrolyte fuel cells [DE91-016027] N91-32573

**ELECTROLYTIC POLARIZATION**
Sodium-metal chloride battery research at JPL N91-32566

**ELECTROMAGNETIC COUPLING**
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 2 [NASA-CP-3106-VOL-2] N91-32693
Electromagnetic topology: Characterization of internal electromagnetic coupling N91-32699
A real scale simulator for high frequency LEMP N91-32700
A theoretical analysis of the electromagnetic environment of the AS330 super Puma helicopter external and internal coupling N91-32701

**ELECTROMAGNETIC FIELDS**
Mode-stirred chamber field statistics: Correlation widths [DE91-016190] N91-32289
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601
Intracloud development of lightning strikes to aircraft N91-32602
The Sandia transportable triggered lightning instrumentation facility N91-32636
FD-TD numerical simulation of an entire lightning strike on the C160 aircraft N91-32648
The electric field changes and UHF radiations caused by the triggered lightning in Japan N91-32652
Horizontal fields generated by return strokes N91-32658
A theoretical analysis of the electromagnetic environment of the AS330 super Puma helicopter external and internal coupling N91-32701
Implementation of the FAA research and development electromagnetic database N91-32715
Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography [PB91-173351] N91-32755
Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] N91-32756
Basic features of coherent radiation generated by relativistic charge bunches [DE91-017656] N91-32898

**ELECTROMAGNETIC INTERACTIONS**
Modeling of electrically thick materials theoretical and experimental aspects N91-32605

**ELECTROMAGNETIC INTERFERENCE**
Electromagnetic emissions from an electro-impulse deicing system in a composite wing equipped with lightning protection [DOT/FAA/CT-TN90/32] N91-32284
Electromagnetic topology: Characterization of internal electromagnetic coupling N91-32699

**ELECTROMAGNETIC NOISE**
Wideband HF noise/interference modeling, part 1. First-order statistics. Technical memorandum series [PB91-208454] N91-32281
Designs for surge immunity in critical electronic facilities N91-32635

**ELECTROMAGNETIC PULSES**
Propagation Limitations for Systems Using Band-Spreading [AGARD-LS-172] N91-32241
Electromagnetic emissions from an electro-impulse deicing system in a composite wing equipped with lightning protection [DOT/FAA/CT-TN90/32] N91-32284
Activation of the Navy's indirect effects lightning simulation laboratory N91-32628
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 2 [NASA-CP-3106-VOL-2] N91-32693
A real scale simulator for high frequency LEMP N91-32700
Diffuse dispersive delay and the time convolution/attenuation of transients N91-32730

**ELECTROMAGNETIC RADIATION**
The electric field changes and UHF radiations caused by the triggered lightning in Japan N91-32652

Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography
[PB91-173351] N91-32755
Basic features of coherent radiation generated by relativistic charge bunches
[DE91-017656] N91-32898

**ELECTROMAGNETIC SHIELDING**
Electromagnetic emissions from an electro-impulse deicing system in a composite wing equipped with lightning protection
[DOT/FAA/CT-TN90/32] N91-32284

**ELECTROMAGNETIC SPECTRA**
Fermi surface measurements in YBa2Cu3O(7-x) and La(1.874)Sr(126)CuO4
[DE91-017094] N91-32973

**ELECTROMECHANICAL DEVICES**
Summary of EEE component anomalies encountered in the SPOT line of Earth observation satellites and lessons derived therefrom for future generations N91-32367
A statistical evaluation of EEE-parts procurement data from telecommunication satellites N91-32368
The history of space quality EEE parts in the United States N91-32370
Rationales for the selection of a parts procurement system (coordinated versus centralized) from a prime contractor point of view N91-32371
EEC component procurement: A look ahead N91-32372
NASA's challenge for tomorrow N91-32374
Parts management for the 1990's N91-32375
Cost effective electronic components for short life space missions N91-32387
A comparison of the specifications for standard Electrical, Electronic and Electromechanical (EEE) parts used by the National Aeronautics and Space Admininstration (NASA) and the European Space Agency (ESA): Towards common specifications N91-32391

**ELECTRON BEAMS**
Advances in SEM beam micro-irradiation N91-32360
Small signal gain for parabolic profile beams in free electron lasers
[DE91-016236] N91-32478
Applications of synchroscan and dual-sweep streak camera techniques to free-electron laser experiments
[DE91-016017] N91-32479
Coherent-state description of free-electron lasers
[DE91-017077] N91-32486
Spontaneous emission from free electron lasers
[DE91-017820] N91-32491
The Los Alamos photoinjector-driven free-electron laser
[DE91-017824] N91-32492
Simulation of APLE photoinjector
[DE91-018048] N91-32493
Computation applied to particle accelerator simulations
[DE91-017128] N91-32906

**ELECTRON CAPTURE**
Ultrarelativistic atomic collisions
[DE91-016768] N91-32884

**ELECTRON DENSITY (CONCENTRATION)**
Observations of Enhanced Radar Backscatter (ERB) from Millstone Hill
[NASA-CR-188877] N91-32280

**ELECTRON DIFFRACTION**
Dynamics of surface melting
[DE91-016344] N91-32206
Picosecond time-resolved electron diffraction studies of laser heated metals
[DE91-016345] N91-32207

**ELECTRON DISTRIBUTION**
Electron distribution functions in electric field environments N91-32726

**ELECTRON ENERGY**
Electron energies in metals
[DE91-016759] N91-32214

**ELECTRON IRRADIATION**
Advances in SEM beam micro-irradiation N91-32360

**ELECTRON MICROSCOPES**
Advances in SEM beam micro-irradiation N91-32360

**ELECTRON MOBILITY**
A cooled 1- to 2-GHz balanced HEMT amplifier N91-32254

**ELECTRON OPTICS**
Beam optics of the AmPS extraction line
[NIKHEF-K/AMPS/91-01] N91-32914

**ELECTRON SCATTERING**
Atomic and molecular collision processes
[DE91-017649] N91-32897

**ELECTRON SPIN**
The role of spin chemistry in the primary events of photosynthesis
[DE91-017301] N91-32752

**ELECTRON TRANSFER**
Electronic transport properties in copper oxides
[DE91-018182] N91-32213
The role of spin chemistry in the primary events of photosynthesis
[DE91-017301] N91-32752
Crossed beams studies of nonadiabatic collision dynamics
[DE91-016250] N91-32879
Photoinitiated electron transfer in multi-chromophoric species: Synthetic tetrads and pentads featuring diquinone moieties
[DE91-017413] N91-32896

**ELECTRON-POSITRON PAIRS**
Fermi surface measurements in YBa2Cu3O(7-x) and La(1.874)Sr(126)CuO4
[DE91-017094] N91-32973

**ELECTRONIC CONTROL**
Lightning protection of full authority digital electronic systems N91-32643

**ELECTRONIC EQUIPMENT**
Protection of electrical and electronic equipment against lightning indirect effects on the Airbus A340 wing N91-32613
Designs for surge immunity in critical electronic facilities N91-32635
A new approach to equipment testing N91-32639
Lightning protection of full authority digital electronic systems N91-32643
Lightning testing at the subsystem level N91-32714
Certification of lightning protection for a full-authority digital engine control N91-32718

**ELECTRONIC EQUIPMENT TESTS**
CARPET: A versatile program for radar performance analysis
[FEL-91-B002] N91-32246
Testing interconnected VLSI circuits in the Big Viterbi Decoder N91-32265
ESA Electronic Components Conference
[ESA-SP-313] N91-32291
Development of semiconductor test structures for reliability evaluation N91-32292
CNES activities on ASIC N91-32298
Assessment of DFT strategies N91-32301
An evaluation programme for the capability approval of GaAs MMICs N91-32303
Test on opto couplers in the linear application considering temperature, radiation and Vce effects N91-32314
Space qualification test and evaluation of JHU/APL designed ASICs N91-32315
Qualification status of hybrid crystal oscillators style OTO 16S for space application N91-32322
An advanced testability concept for space applications N91-32323
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325
Surface mount technology on PCBs at Alcatel Espace N91-32326
Test chips and ASIC qualification N91-32327
The NASA Microelectronics Space Radiation Effects Program (MSREP) at the Jet Propulsion Laboratory N91-32331
Displacement threshold energy in GaAs determined by electrical and optical investigations N91-32337
Radiation sensitivity of power MOSFETS N91-32344
Trends in latch-up sensitivity N91-32345
Irradiation tests and radiation hardness prediction considerations on electronic components for space application N91-32355
The pre-screening of large semiconductor memories for space application N91-32357
Radiation assessment of the INMOS transputer family N91-32358
Advances in SEM beam micro-irradiation N91-32360
Evaluation of FPGAs N91-32361
EQML: A chance for Europe N91-32383
Cost effective electronic components for short life space missions N91-32387
ABB Hafo's ESA approved capability domain for CMOS/SOS ASICs N91-32388
Is the ESA/SCC screening technique more efficient than the MIL specifications? N91-32392
Specification, procurement and testing of passivated microwave semiconductor chips for space applications N91-32393
Lightning testing at the subsystem level N91-32714

**ELECTRONIC MAIL**
Collaboration technology and space science
[NASA-CR-188861] N91-32846

**ELECTRONIC MODULES**
The role of photosensitive polyimides in the development of hybrid space hardware N91-32321

**ELECTRONIC PACKAGING**
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 1: Design and ground tests N91-32269
Spacecraft power system concerns regarding failure modes within complex integrated circuits and hybrid packages N91-32308
High performance packages for space applications N91-32311
Qualification strategy for multi-chip packaging for space applications N91-32312
Withstanding voltage degradation of EEE components due to cavity pressure loss N91-32313
High performance packages for space applications: Review of packaging and assembly methods for long wavelength laser diodes N91-32318
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325
MTSL-005: Reliability evaluation of high pincount hermetic ceramic packages for space applications N91-32328

**ELECTROSTATIC PROBES**
Self-generated stochastic heating in an RF discharge
[DE91-017404] N91-32948

**ELECTROSTATIC SHIELDING**
Charge control experiments on a CH-53E helicopter in a dusty environment N91-32625

**ELECTROSTATICS**
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1
[NASA-CP-3106-VOL-1] N91-32599
Hardening communication ports for survival in electrical overstress environments N91-32624
Beam optics of the AmPS extraction line
[NIKHEF-K/AMPS/91-01] N91-32914

**ELEMENTARY PARTICLES**
Effective theories and thresholds in particle physics
[DE91-016257] N91-32880
Research program in elementary particle theory (task A)
[DE91-016937] N91-32895
Particle astrophysics N91-33024

**EMISSION**
Coalescing binary systems of compact objects to (post) sup 5/2 Newtonian order: Late-time evolution and gravitational radiation emission N91-33037

**EMISSIVITY**
Calibration source for electron cyclotron emission measurements
[NIFS-19] N91-32913

**EMITTANCE**
Spontaneous emission from free electron lasers
[DE91-017820] N91-32491
Gamma ray collimator
[NASA-CASE-SSC-00013-1] N91-32515
Emittance variations in current-amplifying ion induction linacs
[DE91-016266] N91-32909

**END EFFECTORS**
A unified motion planning approach for redundant and nonredundant manipulators with actuator constraints N91-32494
Dynamics modeling and control of a flexible robot arm N91-32495

**ENDOTHERMIC REACTIONS**
Ionization of NO at high temperature
[NASA-CR-188798] N91-32187

**ENERGETIC PARTICLES**
Solar particle events during the rising phase of solar cycle 22
[DE91-016042] N91-33049

**ENERGY BUDGETS**
Displacement threshold energy in GaAs determined by electrical and optical investigations N91-32337

**ENERGY CONSERVATION**
Office of Industrial Technologies research in progress
[DE91-014180] N91-32571
Nature and technology: Energy technology, mankind, and nature in the 21st century
[DLR-MITT-91-05] N91-32581
A guidebook for the control of summer heat islands
[DE91-016246] N91-32586

**ENERGY CONSUMPTION**
Office of Industrial Technologies research in progress
[DE91-014180] N91-32571
A guidebook for the control of summer heat islands
[DE91-016246] N91-32586

**ENERGY CONVERSION**
Natural gas conversion process
[DE91-015759] N91-32235
Flywheel-powered shuttle car
[PB91-200543] N91-32499
Information of meteorological extremes for the design and operation of energy systems
[WCAP-13] N91-32659
Particulate models of photosynthesis
[DE91-016842] N91-32751

**ENERGY CONVERSION EFFICIENCY**
High energy efficiency and high power density proton exchange membrane fuel cells: Electrode kinetics and mass transport N91-32558
Status of NASA's Stirling Space Power Converter Program
[NASA-TM-104512] N91-32569
Office of Industrial Technologies research in progress
[DE91-014180] N91-32571
Information of meteorological extremes for the design and operation of energy systems
[WCAP-13] N91-32659
**ENERGY DISSIPATION**
Comparison of kinetic, equilibrium, and frozen rocket expansion obtained at different propulsive parameters for launcher and spacecraft engines
[DLR-MITT-91-02] N91-32159
Power and energy dissipation in subsequent return strokes as predicted by a new return stroke model N91-32657
Hamiltonians and Lagrangians for one-dimensional autonomous systems and dissipative systems
[DE91-017595] N91-32868
**ENERGY DISTRIBUTION**
Crossed beams studies of nonadiabatic collision dynamics
[DE91-016250] N91-32879
**ENERGY LEVELS**
Electron energies in metals
[DE91-016759] N91-32214
High-intensity photoionization of H2
[DE91-017087] N91-32885
**ENERGY POLICY**
To what extent can Renewable Energy (RE) systems replace carbon-based fuels in the next 15, 50, and 100 years? Eight answers
[DLR-MITT-91-04] N91-32568
Office of Industrial Technologies research in progress
[DE91-014180] N91-32571
Wind energy potential in the United States considering environmental and land-use exclusions
[DE91-017535] N91-32577
Information of meteorological extremes for the design and operation of energy systems
[WCAP-13] N91-32659
**ENERGY SPECTRA**
Spectral transfer analysis for subgrid-scale modelling N91-32438
**ENERGY STORAGE**
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
Regenerative fuel cell architectures for lunar surface power N91-32560
Site-specific investigations on aquifer thermal energy storage for space and process cooling
[DE91-017534] N91-32576
**ENERGY TECHNOLOGY**
To what extent can Renewable Energy (RE) systems replace carbon-based fuels in the next 15, 50, and 100 years? Eight answers
[DLR-MITT-91-04] N91-32568
Energy and technology review
[DE91-016873] N91-32572
Nature and technology: Energy technology, mankind, and nature in the 21st century
[DLR-MITT-91-05] N91-32581
Geoengineering the climate
[DE91-017654] N91-32589
**ENERGY TRANSFER**
Turbulent energy exchange between atmosphere and surface layer. Methodology, measuring technical realizations, their limits, and possible uses
[ISBN-3-88148-263-6] N91-32596
**ENGINE CONTROL**
Preliminary flight evaluation of an engine performance optimization algorithm
[NASA-TM-4328] N91-32140
Fiber-optic applications for space-based engines
[NASA-TM-105235] N91-32163
Design of lightning protection for a full-authority digital engine control N91-32717
Certification of lightning protection for a full-authority digital engine control N91-32718
**ENGINE DESIGN**
Review of Air Force compressor blade and vane rework and it's impact on performance and costs
[AD-A229518] N91-32136
The Navy/NASA Engine Program (NNEP89): Interfacing the program for the calculation of complex Chemical Equilibrium Compositions (CEC)
[NASA-CR-187208] N91-32141
Comparison of kinetic, equilibrium, and frozen rocket expansion obtained at different propulsive parameters for launcher and spacecraft engines
[DLR-MITT-91-02] N91-32159
Status of NASA's Stirling Space Power Converter Program
[NASA-TM-104512] N91-32569
**ENGINE MONITORING INSTRUMENTS**
Fiber-optic applications for space-based engines
[NASA-TM-105235] N91-32163
**ENGINE PARTS**
Inherently safe nuclear-driven internal combustion engines
[DE91-016568] N91-32503
**ENGINE TESTS**
A comparison of the analytical and experimental performance of the solid version of a cooled radial turbine
[NASA-CR-187195] N91-32077
**ENTHALPY**
Advantages of enthalpy-temperature diagrams for nonazeotropic refrigerant mixtures
[DE91-016774] N91-32991
**ENVIRONMENT EFFECTS**
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588
Finiteness: On constraints of applied research
[DLR-MITT-91-06] N91-33001
**ENVIRONMENT POLLUTION**
Chemical tracer studies at IOSDL-2: A method manual for the routine measurement of chlorofluocarbons in seawater and air
[IOS-275] N91-32580
**ENVIRONMENT PROTECTION**
Environmental radioactivity measurement intercomparison exercise 1990
[NPL-RSA(EXT)-20] N91-32875
**ENVIRONMENT SIMULATION**
Activation of the Navy's indirect effects lightning simulation laboratory N91-32628
**ENVIRONMENTAL ENGINEERING**
Nature and technology: Energy technology, mankind, and nature in the 21st century
[DLR-MITT-91-05] N91-32581
**EPIDEMIOLOGY**
Interaction of extremely-low-frequency electromagnetic fields with humans
[DE91-015779] N91-32756
**EPOXY MATRIX COMPOSITES**
Materials and processes laboratory composite materials characterization task, part 1. Damage tolerance
[NASA-TM-103553] N91-32185
**EPOXY RESINS**
Surface modification of high-strength reinforcing fibers by plasma treatment
[DE91-016481] N91-32226
**EQUATIONS OF MOTION**
RV strings of maximum curvature
[DE91-016708] N91-32157
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525
Hamiltonians and Lagrangians for one-dimensional autonomous systems and dissipative systems
[DE91-017595] N91-32868
Gaussian elimination methods for calculating classical periodic trajectories in two dimensions
[DE91-017600] N91-32869
A new variational formulation of kinetic plasma theory and the application of moving finite elements
[DE91-016072] N91-32938
Coalescing binary systems of compact objects to (post) sup 5/2 Newtonian order: Late-time evolution and gravitational radiation emission N91-33037
**EQUATIONS OF STATE**
Equations of state for solid NaCl-KCl and liquid NaCl-KCl-H2O
[DE91-016980] N91-32195
Shock-vaporization studies on zinc and porous carbon
[DE91-017846] N91-32233
User's manual for PANDA 2: A computer code for calculating equations of state
[DE91-017717] N91-32843
Review of the heavy ion physics sessions
[DE91-017828] N91-32912
Baryon inhomogeneity from the cosmic quark-hadron phase transition
[DE91-016608] N91-33051
**EQUIPMENT SPECIFICATIONS**
The history of space quality EEE parts in the United States N91-32370
A comparison of the specifications for standard Electrical, Electronic and Electromechanical (EEE) parts used by the National Aeronautics and Space Admininstration (NASA) and the European Space Agency (ESA): Towards common specifications N91-32391
**EQUIVALENT CIRCUITS**
Equivalent circuit model of traveling-wave maser slow-wave structures N91-32256
Impedances of nickel electrodes cycled in various KOH concentrations N91-32557
**EROSION**
Corrosion and arc erosion in MHD channels
[DE91-016829] N91-32939
**ERROR ANALYSIS**
Uncertainty analysis of a radome flush orifice air motion system for the measurement of aircraft incident angles
[PB91-198176] N91-32133
A study of geographically correlated orbit errors for Topex-incorporating GPS data N91-32154
Orr-Sherby-Dorn creep strengths of the refractory-metal alloys C-103, ASTAR-811C, W-5Re, and W-25Re
[NASA-TM-105228] N91-32165
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251
Modeling and simulations of the DSS 13 antenna control system N91-32268
Electrical emissions of airplanes flying in electrified clouds and their effect on airplane measurements of cloud electric fields N91-32609
On error sources during airborne measurements of the ambient electric field N91-32719
**ERROR CORRECTING CODES**
Coding gains and error rates from the Big Viterbi Decoder N91-32264
Testing interconnected VLSI circuits in the Big Viterbi Decoder N91-32265
Frame error rate of the NASA concatenated coding system N91-32266
Initial pointing calibrations for the DSS 13 34-meter beam-waveguide antenna N91-32267
The effect of the Earth's oblate spheroid shape on the accuracy of a time-of-arrival lightning ground strike locating system N91-32706
**ERRORS**
Feedback controlled optics with wavefront compensation
[NASA-CASE-NPO-18194-1-CU] N91-32924
**ESTERS**
Addition polyimides with enhanced processability
[NASA-CASE-LEW-15043-1] N91-32230
**ETCHING**
Method for anisotropic etching in the manufacture of semiconductor devices
[NASA-CASE-MSC-21631-1] N91-32947
**ETHERS**
High octane ethers from synthesis gas-derived alcohols
[DE91-016596] N91-32193
**ETHYLENE**
New directions for the catalytic conversion of methane
[PB91-206417] N91-32191
**ETHYLENE COMPOUNDS**
Magnetic relaxation of the organic superconductor kappa-(BEDT-TTF)2Cu(N(CN)2)Br
[DE91-016528] N91-32969
**EULER EQUATIONS OF MOTION**
Computational Fluid Dynamics
[VKI-LS-1991-01] N91-32426
The Euler and Navier-Stokes equations. Wellposedness, stability and composite grids N91-32427
Upwind methods and multidimensional splittings for the Euler equations N91-32429
Fluctuation splitting schemes for the 2D Euler equations N91-32430
**EUROPE**
Krupp Technical Reports, number 2, December 1990 (English version)
[ISSN-0930-9276] N91-32994
Europe 1993: The single European market and R and D policy at Krupp N91-32995
The role of Krupp Forschungsinstitut in international R and D cooperation N91-32996
Know-how for Europe N91-32997
Europe 1993: Challenge and opportunity for distribution logistics N91-32998
A political scenario for Europe: Pan-European security system
[FFI-91/5009] N91-33015
**EUROPEAN AIRBUS**
Protection of electrical and electronic equipment against lightning indirect effects on the Airbus A340 wing N91-32613
**EUROPEAN SPACE AGENCY**
ESA software engineering standards, issue 2
[ESA-PSS-05-0-ISSUE-2] N91-32811
**EUROPEAN SPACE PROGRAMS**
ESA Electronic Components Conference
[ESA-SP-313] N91-32291
Single event effects by protons on low Earth orbits: A problem for European manned space missions N91-32349
Total dose characterization of new components for the ESA radiation effects database N91-32362

ESA's component programme plan N91-32373
**EUTECTIC ALLOYS**
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325
**EVALUATION**
Bipolar microwave transistor technology N91-32324
Test structures and measurement techniques for radiation hardening N91-32332
**EVOLUTION (DEVELOPMENT)**
Evolutionary tree reconstruction
[NASA-CR-188862] N91-32816
**EXCIMER LASERS**
Photogenerated carrier-induced reactions on semiconductor surfaces
[DE91-017550] N91-32416
**EXCITATION**
The effect of a neutrino magnetic moment on nuclear excitation processes
[RAL-91-010] N91-32876
Giant resonances in single and double charge exchange
[DE91-017822] N91-32900
Excitation of nonlinear wake field in a plasma for particle acceleration
[DE91-017386] N91-32945
**EXHAUST EMISSION**
Effects of oxygen enrichment and fuel emulsification on diesel engine performance and emissions
[DE91-016520] N91-32506
**EXHAUST GASES**
Geoengineering the climate
[DE91-017654] N91-32589
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656
**EXOTHERMIC REACTIONS**
Ionization of NO at high temperature
[NASA-CR-188798] N91-32187
**EXPANDABLE STRUCTURES**
Deployment and testing of a second prototype expandable surgical chamber in microgravity N91-32794
**EXPERIMENT DESIGN**
Smart instruments and the national collaboratory
[NASA-CR-188902] N91-32472
**EXPERIMENTATION**
Smart instruments and the national collaboratory
[NASA-CR-188902] N91-32472
**EXPERT SYSTEMS**
Application of AI to engineering problems N91-32033
Machine learning research 1989-90
[NASA-CR-188828] N91-32826
An intelligent tutoring system for the investigation of high performance skill acquisition
[NASA-CR-188827] N91-32827
Advanced Software Development Workstation Project, phase 3
[NASA-CR-188824] N91-32828
Advanced software development workstation project ACCESS user's guide
[NASA-CR-188823] N91-32829
ART-Ada: An Ada-based expert system tool
[NASA-CR-188930] N91-32837
Ada issues in implementing ART-Ada
[NASA-CR-188941] N91-32838
Toward the efficient implementation of expert systems in Ada
[NASA-CR-188942] N91-32839
A NASA/RAE cooperation in the development of a real-time knowledge-based autopilot
[NASA-TM-104234] N91-32850
From an automated flight-test management system to a flight-test engineer's workstation
[NASA-TM-104242] N91-32851
Evaluation of knowledge-based system development tools
[DE91-017241] N91-32860
The case for lower probabilities as measures of uncertainty
[DE91-017870] N91-32870
Krupp Technical Reports, number 2, December 1990 (English version)
[ISSN-0930-9276] N91-32994
Know-how for Europe N91-32997
**EXPLOSIVE DEVICES**
Interim explosives detection alternatives
[DE91-016188] N91-32089
**EXPLOSIVES**
Interim explosives detection alternatives
[DE91-016188] N91-32089
**EXPOSURE**
Interaction of extremely-low-frequency electromagnetic fields with humans
[DE91-015779] N91-32756
Assessing the risk of chronic lung injury attributable to long-term ozone exposure
[DE91-016814] N91-32757
**EXTERNAL TANKS**
Lightning protection for shuttle propulsion elements N91-32630
**EXTINCTION**
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539
In situ measurements of light extinction of stratospheric aerosols N91-32541
**EXTRAGALACTIC RADIO SOURCES**
JPL 1990-3: A 5-nrad extragalactic source catalog based on combined radio interferometric observations N91-32276
Asymmetries in extragalactic radio sources N91-33050
**EXTREME ULTRAVIOLET RADIATION**
Small signal gain for parabolic profile beams in free electron lasers
[DE91-016236] N91-32478
**EXTREMELY HIGH FREQUENCIES**
Channel assignments and array gain bounds for the Ka-band array feed compensation system N91-32263
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 2: Tests on the antenna N91-32270
**EXTREMELY LOW FREQUENCIES**
Interaction of extremely-low-frequency electromagnetic fields with humans
[DE91-015779] N91-32756

## F

**F-15 AIRCRAFT**
Preliminary flight evaluation of an engine performance optimization algorithm
[NASA-TM-4328] N91-32140
Noise levels of USAF aircraft in exercise Luce Belle
[NPL-RSA(EXT)-16] N91-32873
**F-16 AIRCRAFT**
Noise levels of USAF aircraft in exercise Luce Belle
[NPL-RSA(EXT)-16] N91-32873
**FABRICATION**
Silver lined ceramic vessel and method of preparation
[AD-D014953] N91-32224
Nozzle fabrication technique
[NASA-CASE-MSC-21299-2] N91-32508
**FABRICS**
Materials compatibility issues for fabric composite radiators
[DE91-017556] N91-32186
**FACTORIZATION**
Lanczos eigensolution method for high-performance computers
[NASA-TM-104108] N91-32526
**FAILURE**
Discussions on a long gap discharge to an EHV transmission tower by a rocket triggered lightning experiment N91-32654
**FAILURE ANALYSIS**
Assessment of DFT strategies N91-32301
A survey of the parasitic effects and degradation mechanisms affecting the GaAs FET-based IC's: The first step for a technological evaluation N91-32304
Reliability of microwave bipolar silicon transistors N91-32305
Simulation of radiation induced circuit failure modes in SOS integrated circuits N91-32351
Results and considerations on failure investigations of components used for space equipment N91-32365
The merits of an independent pre-cap inspection N91-32378
Component field failure data base N91-32380
Development and operation of a solid-state switch for thyratron replacement
[DE91-016553] N91-32401
Investigations into the damage for various types of unprotected carbon fibre composites with a variety of lightning arc attachments N91-32606
The performance of cable braids and terminations to lightning induced transients N91-32611
**FAILURE MODES**
Spacecraft power system concerns regarding failure modes within complex integrated circuits and hybrid packages N91-32308
Simulation of radiation induced circuit failure modes in SOS integrated circuits N91-32351
Results and considerations on failure investigations of components used for space equipment N91-32365
Development and operation of a solid-state switch for thyratron replacement
[DE91-016553] N91-32401
**FAR FIELDS**
Method and apparatus for phasing segmented mirror arrays
[NASA-CASE-NPO-18095-1-CU] N91-32923
**FARADAY EFFECT**
X ray dichroism and Faraday effect studies in ordered and disordered Fe3Pt
[DE91-017305] N91-32974
**FAST NEUTRONS**
Fast neutron dosimetry
[DE91-016907] N91-32894
**FASTENERS**
Two fault tolerant toggle-hook release
[NASA-CASE-MSC-21671-1] N91-32498
**FATIGUE (MATERIALS)**
Tensile and cyclic fatigue properties of SiC whisker-reinforced Al2O3
[DE91-015916] N91-32179
**FAULT TOLERANCE**
A solid state mass memory for space applications: Technological and system aspects N91-32329
Two fault tolerant toggle-hook release
[NASA-CASE-MSC-21671-1] N91-32498
**FEED SYSTEMS**
Space water electrolysis: Space Station through advance missions N91-32553
**FEEDBACK**
Nonlinear feedbacks between stratocumulus and synoptic-scale systems N91-32674
**FEEDBACK CONTROL**
Control design variable linking for optimization of structural/control systems N91-32144
Active damping using a control structure interaction approach N91-32290
Dynamics modeling and control of a flexible robot arm N91-32495
Feedback controlled optics with wavefront compensation
[NASA-CASE-NPO-18194-1-CU] N91-32924
**FEEDFORWARD CONTROL**
Analog hardware for learning neural networks
[NASA-CASE-NPO-17664-1-CU] N91-32852
**FERMI SURFACES**
De Haas van Alphen effect in high temperature superconductors
[DE91-016198] N91-32397
Fermi surface measurements in YBa2Cu3O(7-x) and La(1.874)Sr(126)CuO4
[DE91-017094] N91-32973
**FERMIONS**
Inconsistencies with the single impurity Undersign model in photoelectron spectra of cerium heavy fermion compounds
[DE91-016239] N91-32878
**FERROMAGNETISM**
High energy spin waves in iron measured by neutron scattering
[DE91-017868] N91-32902
**FIBER COMPOSITES**
Composite-faced sandwich construction for primary spacecraft structures N91-32170
Matrix-dominated thermoviscoplasticity in fibrous metal-matrix composite materials N91-32173
Effect of lightning strike on bromine intercalated graphite fiber/epoxy composites
[NASA-TM-104507] N91-32177
Structural characterization of high temperature composites
[NASA-CR-187220] N91-32180
Delaminations in composite plates under transverse static or impact loads N91-32183
Materials compatibility issues for fabric composite radiators
[DE91-017556] N91-32186
Simplified micromechanical equations for thermal residual stress analysis of coated fiber composites
[NASA-CR-187599] N91-32527
Investigations into the damage for various types of unprotected carbon fibre composites with a variety of lightning arc attachments N91-32606
The electromagnetic environment in CFC structures N91-32638
Lightning induced currents in aircraft wiring using low level injection techniques N91-32694
**FIBER OPTICS**
Fiber-optic applications for space-based engines
[NASA-TM-105235] N91-32163
Visible spectroscopy diagnostics of light-ion beams
[DE91-017450] N91-32908
**FIBERS**
Surface modification of high-strength reinforcing fibers by plasma treatment
[DE91-016481] N91-32226
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770
**FIBRILLATION**
Step voltage analysis for the catenoid lightning protection system N91-32623

**FIELD ALIGNED CURRENTS**
Observations of Enhanced Radar Backscatter (ERB) from Millstone Hill
[NASA-CR-188877] N91-32280
**FIELD EFFECT TRANSISTORS**
Optimization of CMOS technology and design for deep cryogenic analog circuits N91-32296
Design, development, and qualification of special super N-channel MOSFET die for space applications N91-32297
A survey of the parasitic effects and degradation mechanisms affecting the GaAs FET-based IC's: The first step for a technological evaluation N91-32304
Temperature compensation of PMOS dosimeters N91-32336
Radiation sensitivity of power MOSFETS N91-32344
Advances in SEM beam micro-irradiation N91-32360
Space radiation effects on power MOSFET: Threshold-voltage shift with dose rate N91-32363
Specification, procurement and testing of passivated microwave semiconductor chips for space applications N91-32393
Resistive gate magnetic field sensor
[AD-D014952] N91-32471
**FIELD STRENGTH**
The detection of the electric field vertical distribution underneath thundercloud: Principle and applications N91-32653
**FIELD THEORY (PHYSICS)**
Effective theories and thresholds in particle physics
[DE91-016257] N91-32880
**FIGHTER AIRCRAFT**
A real scale simulator for high frequency LEMP N91-32700
**FILLERS**
Fundamental metallurgical considerations in brazing and soldering
[DE91-016224] N91-32209
**FILM THICKNESS**
Current status of solid-state lithium batteries employing solid redox polymerization cathodes
[DE91-016988] N91-32404
**FILTERS**
Materials qualification technology for ceramic cross-flow filters
[DE91-017715] N91-32232
**FILTRATION**
A literature review of inclusion removal by filtration and flotation
[NPL-DMM(A)-13] N91-32201
**FINANCIAL MANAGEMENT**
The role of Krupp Forschungsinstitut in international R and D cooperation N91-32996
Know-how for Europe N91-32997
**FINE STRUCTURE**
X ray absorption fine structure of systems in the anharmonic limit
[DE91-016070] N91-32892
**FINGERS**
Rotationally actuated prosthetic helping hand
[NASA-CASE-MFS-28426-1] N91-32795
**FINITE DIFFERENCE THEORY**
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics
[NAL-SP-14] N91-32032
An incompressible flow solver N91-32040
Finite difference numerical prediction of aerodynamics for airfoil flying over wavy wall N91-32043
The three dimensional Navier-Stokes simulations of flow over a wing without any turbulent modelling N91-32051
Numerical treatment of laminar flow in curved rectangular channels with entrance region N91-32053
FD-TD calculation with composite materials. Application to C160 aircraft measurements N91-32637
FD-TD numerical simulation of an entire lightning strike on the C160 aircraft N91-32648
A theoretical analysis of the electromagnetic environment of the AS330 super Puma helicopter external and internal coupling N91-32701
Evaluating lightning hazards to building environments using explicit numerical solutions of Maxwell's equations N91-32733
**FINITE ELEMENT METHOD**
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics
[NAL-SP-14] N91-32032
Time domain finite elements in optimal control with application to launch vehicle guidance N91-32156
Algorithms for structural natural-frequency design N91-32252
Modeling and simulations of the DSS 13 antenna control system N91-32268
Stabilized finite element formulations for incompressible flow computations
[UMSI-91/66] N91-32431
Spectral element methods for the unsteady Navier-Stokes equations N91-32432
A study of fracture mechanisms in ATD roller bearing
[NASA-CR-184200] N91-32497
Numerical simulation of a laser welding process
[DE91-016454] N91-32500
Finite element implementation of state variable-based viscoplasticity models
[NASA-CR-187212] N91-32523
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components
[NASA-CR-187196] N91-32524
A new variational formulation of kinetic plasma theory and the application of moving finite elements
[DE91-016072] N91-32938
**FINITE VOLUME METHOD**
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics
[NAL-SP-14] N91-32032
Navier-Stokes simulation for complete aircraft configuration N91-32046
Navier-Stokes flow calculations by an implicit non-centered method N91-32436
Determining finite volume elements for the 2D Navier-Stokes equations
[DE91-016028] N91-32452
An approximate Riemann solver for hypervelocity flows
[NASA-CR-187629] N91-32463
**FINS**
An experimental study of fluctuating pressure loads beneath swept shock/boundary-layer interactions
[NASA-CR-188919] N91-32080
**FISSION**
Inherently safe nuclear-driven internal combustion engines
[DE91-016568] N91-32503
**FLAME PROPAGATION**
Studies in premixed combustion
[DE91-016964] N91-32198
**FLAT CONDUCTORS**
The performance of cable braids and terminations to lightning induced transients N91-32611
**FLAT PLATES**
An experimental study of fluctuating pressure loads beneath swept shock/boundary-layer interactions
[NASA-CR-188919] N91-32080
A k-epsilon modeling of near wall turbulence
[NASA-TM-105238] N91-32460
**FLAVOR (PARTICLE PHYSICS)**
Soft and hard Pomerons: Is there a distinction?
[DE91-016048] N91-32883
**FLEXIBLE BODIES**
Active damping using a control structure interaction approach N91-32290
Nonlinear dynamic analysis of flexible multibody systems
[NASA-CR-187597] N91-32519
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525
**FLIGHT CONTROL**
An example of requirements for Advanced Subsonic Civil Transport (ASCT) flight control system using structured techniques
[NASA-CR-187526] N91-32132
Application of an integrated flight/propulsion control design methodology to a STOVL aircraft
[NASA-TM-105254] N91-32143
Development and evaluation of an inverse solution technique for studying helicopter maneuverability and agility
[NASA-TM-102889] N91-32145
The formal verification of generic interpreters
[NASA-CR-4403] N91-32853
**FLIGHT CREWS**
Management of acute and chronic motion sickness N91-32769
Aircrew part-task training research and development in the 1980s: Lessons learned
[AD-A239456] N91-32773
**FLIGHT HAZARDS**
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1
[NASA-CP-3106-VOL-1] N91-32599
Lightning threat to aircraft: Do we know all we need to know? N91-32600
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601
Intracloud development of lightning strikes to aircraft N91-32602
Current wave-form observed during lightning strikes on aircraft N91-32603
VHF discharges in storm cells producing microbursts N91-32620
FD-TD numerical simulation of an entire lightning strike on the C160 aircraft N91-32648
Observations of bi-directional leader development in a triggered lightning flash N91-32649
Application of surface electrical discharges to the study of lightning strikes on aircraft N91-32650
Scale-model charge-transfer technique for measuring enhancement factors N91-32651
**FLIGHT MANAGEMENT SYSTEMS**
ADS integration into the flight management computer N91-32114
Flight operations and air traffic management integration N91-32122
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
**FLIGHT MECHANICS**
Flight mechanical model for performance calculations and interactions between flight vehicle and ramjet in regard to the flight orbit
[DLR-FB-91-03] N91-32131
**FLIGHT OPERATIONS**
Flight operations and air traffic management integration N91-32122
**FLIGHT SAFETY**
Lightning current rate of rise in the new lightning flash model for the space shuttle program N91-32604
**FLIGHT SIMULATION**
Influence of configuration effects on multiple burst simulation testing N91-32631
**FLIGHT SIMULATORS**
Motion Sickness: Significance in Aerospace Operations and Prophylaxis
[AGARD-LS-175] N91-32759
Simulator sickness N91-32765
**FLIGHT TESTS**
Determination of aerodynamic characteristics from ATTAS flight data gathering for ground-based simulator
[DLR-FB-91-15] N91-32076
Results of MLS/ILS comparison flight test at the Yuma MCAS, Arizona
[DOT/FAA/CT-TN91/10] N91-32092
Preliminary flight evaluation of an engine performance optimization algorithm
[NASA-TM-4328] N91-32140
Results of the recent precipitation static flight test program on the Navy P-3B antisubmarine aircraft N91-32626
Medical evaluations on the KC-135 1990 flight report summary
[NASA-TM-104740] N91-32776
Dental equipment test during zero-gravity flight N91-32778
Mini-rack testbed evaluation N91-32779
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
Evaluation of cardiopulmonary resuscitation techniques in microgravity N91-32789
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility N91-32791
Shuttle Orbiter medical system equipment/supplies evaluation N91-32793
From an automated flight-test management system to a flight-test engineer's workstation
[NASA-TM-104242] N91-32851
**FLOATING POINT ARITHMETIC**
Gigaflop performance on a CRAY-2: Multitasking a computational fluid dynamics application
[NASA-TM-4305] N91-32841
**FLORIDA**
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida
[DE91-017445] N91-32743
**FLOTATION**
A literature review of inclusion removal by filtration and flotation
[NPL-DMM(A)-13] N91-32201
**FLOW CHARACTERISTICS**
Study of flow properties of wet solids using laser induced photo chemical anemometry
[DE91-016877] N91-32454
**FLOW DISTRIBUTION**
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics
[NAL-SP-14] N91-32032
Numerical calculation of flow for scramjet engine N91-32035
Numerical simulations of chemically reacting flow N91-32036
Rarefied gas numerical wind tunnel 6: Delta wing N91-32039
An incompressible flow solver N91-32040

Several issues of visualization techniques in computational fluid dynamics 2 N91-32044
Supersonic inlet flow computations with cavity N91-32049
The three dimensional Navier-Stokes simulations of flow over a wing without any turbulent modelling N91-32051
Numerical treatment of laminar flow in curved rectangular channels with entrance region N91-32053
Active control of vortex shedding frequency by a splitter plate N91-32059
A numerical simulation of two dimensional shear layer N91-32060
Numerical simulation of shock wave emanating from a square shock tube N91-32061
Numerical simulation of thermal convection in a rectangular duct flow N91-32062
Numerical turbulent simulations of unsteady transonic cascade flows N91-32063
Unsteady flow analysis in two-dimensional compressor cascade N91-32064
Analysis of the aerodynamic performance of counter-rotating propeller by means of vortex lattice method N91-32065
Navier-Stokes analysis for flowfield around hovering rotor N91-32066
Numerical analysis of three-dimensional cascade flow N91-32067
Navier-Stokes computations of three-dimensional turbine cascade flows N91-32068
Unsteady flowfield of a propfan at takeoff conditions [NASA-TM-105223] N91-32075
Investigation of radiative interactions in supersonic internal flows [NASA-CR-188820] N91-32078
Unstructured-grid methods development for unsteady aerodynamic and aeroelastic analyses [NASA-TM-104143] N91-32084
An experimental investigation of a supersonic vortical flow [NASA-TM-105102] N91-32085
Studies in premixed combustion [DE91-016964] N91-32198
The development of solution algorithms for compressible flows N91-32423
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies [NASA-CR-187617] N91-32441
Calculation of unsteady linearized Euler flows in cascades using harmonically deforming grids [NASA-CR-188916] N91-32442
Appraisal of the Suitability of Turbulence Models in Flow Calculations [AGARD-AR-291] N91-32443
Turbulence modelling: Survey of activities in Belgium and The Netherlands, an appraisal of the status and a view on the prospects N91-32444
Calculation of turbulent compressible flows N91-32445
Some current approaches in turbulence modelling N91-32446
Turbulence models for natural convection flows along a vertical heated plane N91-32447
Computational turbulence studies in Turkey N91-32449
Appraisal of the suitability of turbulence models in flow calculations: A UK view on turbulence models for turbulent shear flow calculations N91-32450
Collaborative testing of turbulence models N91-32451
An approximate Riemann solver for hypervelocity flows [NASA-CR-187629] N91-32463

**FLOW EQUATIONS**
An incompressible flow solver N91-32040
Unstructured-grid methods development for unsteady aerodynamic and aeroelastic analyses [NASA-TM-104143] N91-32084
Parallelizing the spectral transform method, part 2 [DE91-017131] N91-32456

**FLOW GEOMETRY**
An incompressible flow solver N91-32040

**FLOW MEASUREMENT**
Measurement of interfacial area using four sensor probe in two phase flow [DE91-017415] N91-32466

**FLOW STABILITY**
Developing laminar flow and heat transfer in orthogonally rotating square ducts N91-32054
The Euler and Navier-Stokes equations. Wellposedness, stability and composite grids N91-32427
Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere N91-32673
Laboratory and theoretical models of planetary-scale instabilities and waves N91-32675

**FLOW VISUALIZATION**
Several issues of visualization techniques in computational fluid dynamics 2 N91-32044
Study of flow properties of wet solids using laser induced photo chemical anemometry [DE91-016877] N91-32454

**FLUENCE**
Radiation hardening of diagnostics [DE91-018039] N91-32953

**FLUID DYNAMICS**
Numerical simulation of unsteady compressible viscous flows using an implicit upwind relaxation scheme N91-32041
A k-epsilon modeling of near wall turbulence [NASA-TM-105238] N91-32460
Fluid dynamics of double diffusive systems [DE91-017401] N91-32465

**FLUID FLOW**
Numerical treatment of laminar flow in curved rectangular channels with entrance region N91-32053
Channel flow of a concentrated suspension [DE91-016649] N91-32453
Hamiltonian chaos and transport in quasigeostrophic flows [DE91-017385] N91-32464
Fluid dynamics of double diffusive systems [DE91-017401] N91-32465
Laboratory and theoretical models of planetary-scale instabilities and waves N91-32675

**FLUID MANAGEMENT**
The NASA cryogenic fluid management technology program plan [NASA-TM-105256] N91-32161
Cryogenic Orbital Nitrogen Experiment (CONE): Phase A/B design study [NASA-CR-187230] N91-32166
Microgravity liquid propellant management [NASA-CR-184238] N91-32236

**FLUID MECHANICS**
Fluid dynamics of double diffusive systems [DE91-017401] N91-32465

**FLUORESCENCE**
Optical diagnostics of mercuric iodide crystal growth [DE91-017396] N91-32983

**FLUOROCARBONS**
Chemical tracer studies at IOSDL-2: A method manual for the routine measurement of chlorofluocarbons in seawater and air [IOS-275] N91-32580

**FLUTTER ANALYSIS**
Aeroelastic flutter prevention in gliders and small aircraft [DLR-MITT-91-03] N91-32142

**FLUX DENSITY**
Review of the heavy ion physics sessions [DE91-017828] N91-32912

**FLUX PINNING**
Flux pinning by planar defects in single crystal YBa2Cu3O(7-delta) [DE91-016525] N91-32968
Flux dynamics in high-Tc superconductors [DE91-017977] N91-32988

**FLY BY WIRE CONTROL**
Lightning protection of full authority digital electronic systems N91-32643
The formal verification of generic interpreters [NASA-CR-4403] N91-32853

**FLYBY MISSIONS**
Delta VLBI data performance in the Galileo spacecraft Earth flyby of December 1990 N91-32274

**FLYWHEELS**
Flywheel-powered shuttle car [PB91-200543] N91-32499

**FOCUSING**
A simple sagittal focusing crystal which utilizes a bimetallic strip [DE91-017324] N91-32975

**FORCED CONVECTION**
Turbulence models for natural convection flows along a vertical heated plane N91-32447

**FOREST FIRES**
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539

**FORMALISM**
FD-TD calculation with composite materials. Application to C160 aircraft measurements N91-32637
A unified formalism for gamma gamma to meson and psi to gammaX with possible tests for hybrid and gluonic hadrons [RAL-91-039] N91-32877

**FORMING TECHNIQUES**
Development of a spray-forming process for steel [DE91-015812] N91-32218
Manufacture of containers from an oriented biopolymer N91-32999

**FORTRAN**
The comparison and selection of programming languages for high energy physics applications [DE91-017130] N91-32910

**FOSSIL FUELS**
To what extent can Renewable Energy (RE) systems replace carbon-based fuels in the next 15, 50, and 100 years? Eight answers [DLR-MITT-91-04] N91-32568
Geoengineering the climate [DE91-017654] N91-32589

**FRACTURE MECHANICS**
Advances in the design of toughened ceramics [DE91-016767] N91-32228

**FRACTURE STRENGTH**
Analytical and numerical studies of fracture and fatigue in ceramic materials N91-32516
Fracture characterization for thermoinelasticity N91-32517
Load-line displacements for three-point bend J tests using bottom surface displacements [AD-A229634] N91-32518

**FRACTURING**
Progressive fracture in composites subjected to hygrothermal environment [NASA-TM-105230] N91-32182
A study of fracture mechanisms in ATD roller bearing [NASA-CR-184200] N91-32497

**FRANCE**
French SATCOM program and related international activities N91-32102

**FREE CONVECTION**
Turbulence models for natural convection flows along a vertical heated plane N91-32447

**FREE ELECTRON LASERS**
Small signal gain for parabolic profile beams in free electron lasers [DE91-016236] N91-32478
Applications of synchroscan and dual-sweep streak camera techniques to free-electron laser experiments [DE91-016017] N91-32479
Interferometric results from Boeing grazing incidence ring resonator FEL [DE91-016305] N91-32484
Coherent-state description of free-electron lasers [DE91-017077] N91-32486
Spontaneous emission from free electron lasers [DE91-017820] N91-32491
The Los Alamos photoinjector-driven free-electron laser [DE91-017824] N91-32492
Simulation of APLE photoinjector [DE91-018048] N91-32493

**FREE ENERGY**
Multiheteromacrocycles that complex metal ions [DE91-016292] N91-32205

**FREE FLOW**
Thin layer Navier-Stokes solutions for transonic multibody interference [AD-A234252] N91-32072
An experimental study of fluctuating pressure loads beneath swept shock/boundary-layer interactions [NASA-CR-188919] N91-32080

**FREE-PISTON ENGINES**
Hot gas test results of a miniature free-piston pressurization pump driven by hydrazine decomposition products [DE91-017072] N91-32504
Status of NASA's Stirling Space Power Converter Program [NASA-TM-104512] N91-32569

**FRENCH SPACE PROGRAM**
CECIL: Collaboration between companies and research agencies in heavy ion test of spacecraft microelectronics N91-32348

**FREQUENCY DISTRIBUTION**
Temporal and spectral features of wall pressure fluctuations beneath a turbulent boundary layer N91-32461
Weak positive cloud-to-ground flashes in Northeastern Colorado N91-32712

**FREQUENCY RANGES**
Comparison of high temperature, high frequency core loss and dynamic B-H loops of two 50 Ni-Fe crystalline alloys and an iron-based amorphous alloy [NASA-TM-105205] N91-32412
Characteristics of return stroke electric fields produced by lightning flashes at distances of 1 to 15 kilometers N91-32615

**FRICTION FACTOR**
Linear mass actuator [NASA-CASE-LAR-14352-1] N91-32511
Bidirectional drive and brake mechanism [NASA-CASE-MSC-21540-1] N91-32514

**FRONTS (METEOROLOGY)**
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688
**FUEL CELL POWER PLANTS**
High energy efficiency and high power density proton exchange membrane fuel cells: Electrode kinetics and mass transport N91-32558
Regenerative fuel cell architectures for lunar surface power N91-32560
**FUEL CELLS**
Power system requirements and selection for the space exploration initiative
[DE91-016707] N91-32150
Space Electrochemical Research and Technology
[NASA-CP-3125] N91-32549
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551
Impact of fundamental technical improvements to natural gas fuel cells
[PB91-206615] N91-32570
Modeling water content effects in polymer electrolyte fuel cells
[DE91-016027] N91-32573
**FUEL COMBUSTION**
Autoignition chemistry of C4 olefins under motored engine conditions: A comparison of experimental and modeling results
[DE91-016511] N91-32197
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588
Measurements of some parameters of thermal sparks with respect to their ability to ignite aviation fuel/air mixtures N91-32705
**FUEL CONSUMPTION**
Optimal cooperative time-fixed impulsive rendezvous N91-32153
Effects of oxygen enrichment and fuel emulsification on diesel engine performance and emissions
[DE91-016520] N91-32506
**FUEL INJECTION**
Numerical simulations of chemically reacting flow N91-32036
Effects of oxygen enrichment and fuel emulsification on diesel engine performance and emissions
[DE91-016520] N91-32506
**FUEL PRODUCTION**
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
**FUEL TANKS**
Simulation and measurement of melting effects on metal sheets caused by direct lightning strikes N91-32644
**FUEL-AIR RATIO**
Investigation of radiative interactions in supersonic internal flows
[NASA-CR-188820] N91-32078
**FUNCTION GENERATORS**
A generalized compliant motion primitive
[NASA-CASE-NPO-18134-1-CU] N91-32510
**FUNGAL DISEASES**
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting
[DE91-017545] N91-32758
**FUSION WELDING**
Effect of thermal exposure, forming, and welding on high-temperature, dispersion-strengthened aluminum alloy: Al-8Fe-1V-2Si
[NASA-CR-187575] N91-32200

## G

**GALACTIC EVOLUTION**
Nuclear and astronomical constraints on the site for r-process nucleosynthesis
[DE91-016561] N91-33038
Testing the big bang: Light elements, neutrinos, dark matter, and large-scale structure
[DE91-017379] N91-33040
**GALERKIN METHOD**
Stabilized finite element formulations for incompressible flow computations
[UMSI-91/66] N91-32431
**GALILEO SPACECRAFT**
Analysis of a multiple reception model for processing images from the solid-state imaging camera N91-32259
Delta VLBI data performance in the Galileo spacecraft Earth flyby of December 1990 N91-32274
**GALLIUM**
Liquid and solid Ga and Bi studies with a variable energy positron beam
[DE91-016910] N91-32889
**GALLIUM ARSENIDE LASERS**
Assessment of p-metallisations for high power GaAs laser diodes N91-32316
**GALLIUM ARSENIDES**
GaAs/Ge solar cell for space applications N91-32293
An evaluation programme for the capability approval of GaAs MMICs N91-32303
A survey of the parasitic effects and degradation mechanisms affecting the GaAs FET-based IC's: The first step for a technological evaluation N91-32304
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325
Displacement threshold energy in GaAs determined by electrical and optical investigations N91-32337
Design and evaluation of a GaAs MMIC X-band active RC quadrature power divider
[FEL-91-A076] N91-32396
Planar gallium arsenide NPNP microwave switch
[AD-D014948] N91-32398
Processing issues and technologies for optoelectronics-integrated circuits and devices
[DE91-017451] N91-32406
Wideband microwave generation with GaAs photoconductive switches
[DE91-017544] N91-32415
Photogenerated carrier-induced reactions on semiconductor surfaces
[DE91-017550] N91-32416
Resistive gate magnetic field sensor
[AD-D014952] N91-32471
Monitoring interfacial dynamics by pulsed laser techniques
[DE91-016950] N91-32485
Specular and diffuse scattering studies of multilayer interfaces
[DE91-016893] N91-32978
**GALLIUM COMPOUNDS**
Laser performance and optical properties of LiSrGaF6:Cr(3+)
[DE91-016555] N91-32481
**GAMMA RAY ASTRONOMY**
High energy from space N91-33023
**GAMMA RAY SPECTROMETERS**
Further development of IDGS: Isotope dilution gamma-ray spectrometry
[DE91-016315] N91-32936
**GAMMA RAYS**
Space radiation effects on CCDs N91-32339
Radiation assessment of the INMOS transputer family N91-32358
Neutron, gamma ray and post-irradiation thermal annealing effects on power semiconductor switches
[NASA-TM-105248] N91-32410
Gamma ray collimator
[NASA-CASE-SSC-00013-1] N91-32515
Intercomparison of standards of absorbed dose between the USSR and the UK
[NPL-RSA(EXT)-17] N91-32874
**GANTRY CRANES**
Robot development for nuclear material processing
[DE91-016567] N91-32502
**GAS COMPOSITION**
Geoengineering the climate
[DE91-017654] N91-32589
**GAS DISCHARGES**
Withstanding voltage degradation of EEE components due to cavity pressure loss N91-32313
**GAS FLOW**
Solution of perfect gas viscous flows via compressible Navier-Stokes equations with wallslip conditions
[ONERA-RSF-13/3637-AY] N91-32435
Navier-Stokes flow calculations by an implicit non-centered method N91-32436
Laser-based diagnostics for density, temperature, velocity, and dissociation fraction in high temperature hydrogen flows
[DE91-016323] N91-32480
**GAS GIANT PLANETS**
Laboratory and theoretical models of planetary-scale instabilities and waves N91-32675
**GAS LASERS**
Reliable, high repetition rate thyratron grid driver used with a magnetic modulator
[DE91-016558] N91-32413
**GAS PRESSURE**
Computer modeling of pulsed CO2 lasers for lidar applications N91-32680
**GAS TRANSPORT**
Effect of prior mechanical deformation on hydrogen transport through 13 percent chromium martensitic stainless steel
[NPL-DMM(A)-14] N91-32202
Helium isotopic constraints on terrestrial degassing and the transcrustal transport of mantle methane
[PB91-206458] N91-32594
**GAS TUNGSTEN ARC WELDING**
Gas tungsten arc adaptive welding
[DE91-017848] N91-32513
**GAS TURBINE ENGINES**
Review of Air Force compressor blade and vane rework and it's impact on performance and costs
[AD-A229518] N91-32136
The Navy/NASA Engine Program (NNEP89): Interfacing the program for the calculation of complex Chemical Equilibrium Compositions (CEC)
[NASA-CR-187208] N91-32141
**GAS TURBINES**
A comparison of the analytical and experimental performance of the solid version of a cooled radial turbine
[NASA-CR-187195] N91-32077
**GATES (CIRCUITS)**
Total dose effects in MOS systems: Influence of the initial hydrogen distribution N91-32338
Radiation sensitivity of power MOSFETS N91-32344
Evaluation of FPGAs N91-32361
**GAUSSIAN ELIMINATION**
Gaussian elimination methods for calculating classical periodic trajectories in two dimensions
[DE91-017600] N91-32869
**GENES**
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root
[DE91-016255] N91-32749
**GENETICS**
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root
[DE91-016255] N91-32749
**GEOCHEMISTRY**
Earth sciences report, 1989 - 1990
[DE91-017132] N91-33053
**GEODESY**
The effect of the Earth's oblate spheroid shape on the accuracy of a time-of-arrival lightning ground strike locating system N91-32706
**GEODETIC ACCURACY**
Integrated compensation of geodetic nets in point masses model
[SER-C-362] N91-32547
**GEODETIC SURVEYS**
Integrated compensation of geodetic nets in point masses model
[SER-C-362] N91-32547
**GEOLOGY**
Earth sciences report, 1989 - 1990
[DE91-017132] N91-33053
**GEOMETRIC RECTIFICATION (IMAGERY)**
Parametric rectification of thematic mapper raw data
[DLR-FB-90-55] N91-32543
**GEOPHYSICAL FLUID FLOW CELLS**
Basic studies of baroclinic flows N91-32662
**GEOPHYSICS**
Solar-geophysical data number 560, April 1991. Part 1: (Prompt reports). Data for March, February 1991, and late data
[PB91-193508] N91-33047
Solar-geophysical data number 560, April 1991. Part 2: (Comprehensive reports). Data for October 1990 and miscellaneous
[PB91-193516] N91-33048
**GEOPOTENTIAL**
A study of geographically correlated orbit errors for Topex-incorporating GPS data N91-32154
**GEOPOTENTIAL HEIGHT**
Potential vorticity index N91-32672
**GERMANIUM**
GaAs/Ge solar cell for space applications N91-32293
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium
[DE91-016161] N91-32964
**GERMANY**
The 1980 equalization diagnosis of the German main triangulation network. 5: Neighborhood, conclusions --- thematic maps
[SER-B-272-PT-2] N91-32548
The role of Krupp Forschungsinstitut in international R and D cooperation N91-32996
**GIANT STARS**
Astrophysical neutron capture processes
[DE91-017071] N91-33039
**GLASS**
Structural characterization of high temperature composites
[NASA-CR-187220] N91-32180
Leaching behavior of microtektite glass compositions in sea water and the effect of precipitation on glass leaching
[NASA-TM-105106] N91-32225

Thermal-mechanical and physical-chemical properties of phosphate laser glasses
[DE91-016604] N91-32227
Spectroscopic properties of Nd3+ dopant ions in phosphate laser glass
[DE91-017665] N91-32985

**GLOBAL POSITIONING SYSTEM**
Examinations of the rational utilization of the Global Positioning System (GPS) in local networks
[SER-C-361] N91-32129
A study of geographically correlated orbit errors for Topex-incorporating GPS data N91-32154
JPL 1990-3: A 5-nrad extragalactic source catalog based on combined radio interferometric observations N91-32276

**GLOVES**
Application of telerobotic control to remote processing of nuclear material
[DE91-016562] N91-32501

**GLUONS**
A unified formalism for gamma gamma to meson and psi to gammaX with possible tests for hybrid and gluonic hadrons
[RAL-91-039] N91-32877

**GOLD**
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551

**GOLD ALLOYS**
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325

**GRAIN BOUNDARIES**
Irradiation-induced chromium depletion and its influence on integranular stress corrosion cracking of stainless steels
[DE91-017418] N91-32212
Application of a thermal spike model to experimental ion-induced grain growth data
[DE91-017320] N91-32981

**GRAPH THEORY**
Graph theory and the Virasoro master equation
[DE91-016432] N91-32866

**GRAPHITE**
Ion beam sputtering in electric propulsion facilities
[NASA-TM-105145] N91-32158
Graphite-metal brazing for thermal applications
[DE91-016647] N91-32944

**GRAPHITE-EPOXY COMPOSITES**
Effect of lightning strike on bromine intercalated graphite fiber/epoxy composites
[NASA-TM-104507] N91-32177
Delaminations in composite plates under transverse static or impact loads N91-32183
An assessment of tailoring of lightning protection design requirements for a composite wing structure on a metallic aircraft N91-32641

**GRAPHS (CHARTS)**
Mapping unstructured grid problems to the connection machine
[NASA-CR-187719] N91-32864
Graph theory and the Virasoro master equation
[DE91-016432] N91-32866

**GRATINGS (SPECTRA)**
Analysis of polarization properties of shallow metallic gratings by an extended Rayleigh-Fano theory
[DE91-016982] N91-32835

**GRAVITATIONAL EFFECTS**
Microgravity liquid propellant management
[NASA-CR-184238] N91-32236
Evaluation of aerosolized medications during parabolic flight maneuvers N91-32783
Fluid handling 2: Surgical applications N91-32790

**GRAVITATIONAL FIELDS**
Integrated compensation of geodetic nets in point masses model
[SER-C-362] N91-32547

**GRAVITATIONAL WAVES**
Interferometry N91-33022
Coalescing binary systems of compact objects to (post) sup 5/2 Newtonian order: Late-time evolution and gravitational radiation emission N91-33037

**GRAVITROPISM**
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root
[DE91-016255] N91-32749

**GRAVITY WAVES**
On the nonlinear response of minor atmospheric species to linear gravity waves N91-32593

**GRAY GAS**
Infrared radiative energy transfer in gaseous systems
[NASA-CR-188925] N91-32462

**GRAZING**
Synthetic aperture radar imagery of airports and surrounding areas: Study of clutter at grazing angles and their polarimetric properties
[NASA-CR-4398] N91-32088

**GRAZING INCIDENCE**
Interferometric results from Boeing grazing incidence ring resonator FEL
[DE91-016305] N91-32484

**GREENHOUSE EFFECT**
Geoengineering the climate
[DE91-017654] N91-32589

**GRID GENERATION (MATHEMATICS)**
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics
[NAL-SP-14] N91-32032
Surface grid generation based on unstructured grid N91-32042
Finite difference numerical prediction of aerodynamics for airfoil flying over wavy wall N91-32043
Investigation of advanced counterrotation blade configuration concepts for high speed turboprop systems. Task 3: Advanced fan section grid generator final report and computer program user's manual
[NASA-CR-187129] N91-32138
The development of solution algorithms for compressible flows N91-32423

**GROOVES**
Nozzle fabrication technique
[NASA-CASE-MSC-21299-2] N91-32508

**GROUND BASED CONTROL**
Data Multiplexing Network (DMN), phase 3: Equipment Operational Test and Evaluation (OT&E)/Integration test plan
[DOT/FAA/CT-TN91/24] N91-32283
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms
[DE91-017245] N91-32774

**GROUND EFFECT (COMMUNICATIONS)**
First and subsequent return stroke properties of cloud-to-ground lightning N91-32614
Hardening communication ports for survival in electrical overstress environments N91-32624
The electric field change caused by a ground flash with multiple channels N91-32647

**GROUND STATE**
Single- and double-charge exchange at low pion energies
[DE91-017829] N91-32901

**GROUND STATIONS**
INMARSAT access approval N91-32110
Operational SATCOM: Moving from trials to service N91-32111

**GROUND TESTS**
Evaluation of the damages caused by lightning current flowing through bearings N91-32632

**GROUND WIND**
Surface wind convergence as a short-term predictor of cloud-to-ground lightning at Kennedy Space Center: A four-year summary and evaluation N91-32703
Near ground sound propagation in wind
[CSTB-2-89-003-4] N91-32871

**GROUND-AIR-GROUND COMMUNICATION**
Automatic Dependent Surveillance (ADS) development in Canada N91-32104
ADS communications: A cornerstone N91-32105
System improvements identified by the North Atlantic Systems Planning Group (NAT/SPG) as related to the capabilities of the Oceanic Display and Planning System (ODAPS) N91-32109

**GUIDANCE (MOTION)**
WASP, the Weapon Analysis and Simulation Program
[FEL-90-A322] N91-32813

**GULF OF MEXICO**
Gulf of Mexico circulation modeling study: Annual progress report: Years 3 and 4
[PB91-210666] N91-32746

**GUNS (ORDNANCE)**
Ignitability test method and apparatus
[NASA-CASE-LAR-14454-1] N91-32196
An investigation into the potential use of psychometric instruments for the selection of firearms officers
[CRANFIELD-AERO-9108] N91-32772

## H

**HADRONS**
A dynamical picture of hadron-hadron collisions with the string-parton model
[DE91-016278] N91-32881
Hadronic photons and collider diffractive physics
[DE91-016514] N91-32888
Baryon inhomogeneity from the cosmic quark-hadron phase transition
[DE91-016608] N91-33051

**HALL EFFECT**
Analogous behavior in the quantum hall effect, anyon superconductivity, and the standard model
[DE91-016609] N91-32970

**HALOGEN COMPOUNDS**
Photogenerated carrier-induced reactions on semiconductor surfaces
[DE91-017550] N91-32416

**HAMILTONIAN FUNCTIONS**
Hamiltonians and Lagrangians for one-dimensional autonomous systems and dissipative systems
[DE91-017595] N91-32868

**HANDBOOKS**
Development of a handbook for configuration managers with applications for the program/system in full-scale development
[AD-A229617] N91-32993

**HANDLING EQUIPMENT**
Application of telerobotic control to remote processing of nuclear material
[DE91-016562] N91-32501

**HARMONIC OSCILLATORS**
Small signal gain for parabolic profile beams in free electron lasers
[DE91-016236] N91-32478
Hamiltonians and Lagrangians for one-dimensional autonomous systems and dissipative systems
[DE91-017595] N91-32868

**HAZARDS**
Pressure safety training
[DE91-015717] N91-32238
Evaluating lightning hazards to building environments using explicit numerical solutions of Maxwell's equations N91-32733
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770

**HEAD MOVEMENT**
Space sickness N91-32764

**HEALTH**
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting
[DE91-017545] N91-32758
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770
Dental equipment test during zero-gravity flight N91-32778
Environment, Safety and Health Thesaurus/Dictionary
[DE91-013428] N91-33012

**HEART RATE**
The QT interval in lightning injury with implications for the cessation of metabolism hypothesis N91-32621

**HEAT EXCHANGERS**
Advantages of enthalpy-temperature diagrams for nonazeotropic refrigerant mixtures
[DE91-016774] N91-32991

**HEAT FLUX**
South Pacific convergence zone and global scale circulations (Jul. 1987 - Jul. 1991). Observational and modeling studies of heat, moisture, precipitation, and global-scale circulation patterns (Jul. 1990 - Jul. 1993) N91-32691

**HEAT ISLANDS**
A guidebook for the control of summer heat islands
[DE91-016246] N91-32586

**HEAT PIPES**
Materials compatibility issues for fabric composite radiators
[DE91-017556] N91-32186

**HEAT PUMPS**
Braun heat pump engine/compressor and its hermetic rod seal
[DE91-017151] N91-32239
Advantages of enthalpy-temperature diagrams for nonazeotropic refrigerant mixtures
[DE91-016774] N91-32991

**HEAT RADIATORS**
The essential linearity of thermal radiation net transport
[DE91-016734] N91-32990

**HEAT SOURCES**
South Pacific convergence zone and global scale circulations (Jul. 1987 - Jul. 1991). Observational and modeling studies of heat, moisture, precipitation, and global-scale circulation patterns (Jul. 1990 - Jul. 1993) N91-32691

**HEAT STORAGE**
Site-specific investigations on aquifer thermal energy storage for space and process cooling
[DE91-017534] N91-32576

**HEAT TRANSFER**
Heat transfer effectiveness of a thermal barrier coating with different fuel compositions
[DE91-015602] N91-32222
Multiple cell common pressure vessel nickel hydrogen battery N91-32564
Office of Industrial Technologies research in progress
[DE91-014180] N91-32571
Research on diabatic initialization N91-32671

Monitoring, analyzing, and modeling global climate N91-32689
Synoptic/planetary-scale interactions and blocking over the North Atlantic Ocean N91-32692
Cryogenic cooling of x ray crystals using porous matrix
| DE91-017322 | N91-32982
The essential linearity of thermal radiation net transport
| DE91-016734 | N91-32990

**HEAT TREATMENT**
Projects within the Center for Advanced Materials
| PB91-205716 | N91-32178

**HEATING**
Self-generated stochastic heating in an RF discharge
| DE91-017404 | N91-32948

**HEAVY ELEMENTS**
Nuclear and astronomical constraints on the site for r-process nucleosynthesis
| DE91-016561 | N91-33038

**HEAVY IONS**
Heavy-ion induced single-event upset in integrated circuits N91-32347
CECIL: Collaboration between companies and research agencies in heavy ion test of spacecraft microelectronics N91-32348
A dynamical picture of hadron-hadron collisions with the string-parton model
| DE91-016278 | N91-32881
Ultrarelativistic atomic collisions
| DE91-016768 | N91-32884
Review of the heavy ion physics sessions
| DE91-017828 | N91-32912
Solar particle events during the rising phase of solar cycle 22
| DE91-016042 | N91-33049

**HELICAL FLOW**
An experimental study of natural and forced modes in an axisymmetric jet
| NASA-TM-105225 | N91-32074

**HELICOPTER CONTROL**
Development and evaluation of an inverse solution technique for studying helicopter maneuverability and agility
| NASA-TM-102889 | N91-32145

**HELICOPTER ENGINES**
Charge control experiments on a CH-53E helicopter in a dusty environment N91-32625

**HELICOPTER PERFORMANCE**
Development and evaluation of an inverse solution technique for studying helicopter maneuverability and agility
| NASA-TM-102889 | N91-32145
Charge control experiments on a CH-53E helicopter in a dusty environment N91-32625

**HELICOPTER PROPELLER DRIVE**
Time-frequency domain analysis of helicopter transmission vibration
| ARL-PROP-R-180 | N91-32146

**HELICOPTERS**
Analysis of rotorwash effects in helicopter mishaps
| DOT/FAA/RD-90/17 | N91-32086
A theoretical analysis of the electromagnetic environment of the AS330 super Puma helicopter external and internal coupling N91-32701

**HELIOTRONS**
Development of the stellarator/heliotron research
| NIFS-84 | N91-32957

**HELIPORTS**
Rotorcraft master plan
| AD-A239444 | N91-32081
Analysis of rotorwash effects in helicopter mishaps
| DOT/FAA/RD-90/17 | N91-32086

**HELIUM**
The evolution of US helium-cooled blankets
| DE91-017938 | N91-32952

**HELIUM ISOTOPES**
Helium isotopic constraints on terrestrial degassing and the transcrustal transport of mantle methane
| PB91-206458 | N91-32594

**HERMETIC SEALS**
Withstanding voltage degradation of EEE components due to cavity pressure loss N91-32313

**HERMITIAN POLYNOMIAL**
On polynomial preconditioning for indefinite Hermitian matrices
| NASA-CR-188857 | N91-32814
QMR: A Quasi-Minimal Residual method for non-Hermitian linear systems
| NASA-CR-188882 | N91-32818
An implementation of the look-ahead Lanczos algorithm for non-Hermitian matrices
| NASA-CR-188889 | N91-32820
Krylov subspace methods for complex non-Hermitian linear systems
| NASA-CR-188891 | N91-32821
A biconjugate gradient type algorithm on massively parallel architectures
| NASA-CR-188888 | N91-32848

**HEURISTIC METHODS**
Evolutionary tree reconstruction
| NASA-CR-188862 | N91-32816
Mapping unstructured grid problems to the connection machine
| NASA-CR-187719 | N91-32864

**HIGH CURRENT**
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs)
| DE91-016196 | N91-32407
High current pulse testing for ground rod integrity N91-32737

**HIGH ELECTRON MOBILITY TRANSISTORS**
A cooled 1- to 2-GHz balanced HEMT amplifier N91-32254

**HIGH ENERGY INTERACTIONS**
Study of neutron-proton interaction in the 300 to 700 MeV energy region
| DE91-016487 | N91-32887
Mechanisms of defect production and atomic mixing in high energy displacement cascades: A molecular dynamics study
| DE91-017082 | N91-32979
High energy from space N91-33023

**HIGH FREQUENCIES**
Wideband HF noise/interference modeling, part 1. First-order statistics. Technical memorandum series
| PB91-208454 | N91-32281

**HIGH GAIN**
The promise of magnetized fuel: High gain in inertial confinement fusion
| DE91-016321 | N91-32937

**HIGH POWER LASERS**
High average power magnetic modulator for copper lasers
| DE91-016560 | N91-32482

**HIGH PRESSURE**
High pressure Moessbauer spectroscopy in diamond anvil cells
| DE91-016018 | N91-32961

**HIGH RESOLUTION**
Model calculations for a pushbroom stereo camera: The case of the Mars 94 High Resolution Stereo Camera (HRSC)
| DLR-FB-90-57 | N91-32468
Distortion free projection lithography
| DE91-016570 | N91-32916

**HIGH REYNOLDS NUMBER**
The three dimensional Navier-Stokes simulations of flow over a wing without any turbulent modelling N91-32051
An experimental study of natural and forced modes in an axisymmetric jet
| NASA-TM-105225 | N91-32074

**HIGH TEMPERATURE**
Silver lined ceramic vessel and method of preparation
| AD-D014953 | N91-32224

**HIGH TEMPERATURE ENVIRONMENTS**
Effect of thermal exposure, forming, and welding on high-temperature, dispersion-strengthened aluminum alloy: Al-8Fe-1V-2Si
| NASA-CR-187575 | N91-32200

**HIGH TEMPERATURE GASES**
Spectroscopic wear detector
| NASA-CASE-LEW-15200-1 | N91-32167
Laser-based diagnostics for density, temperature, velocity, and dissociation fraction in high temperature hydrogen flows
| DE91-016323 | N91-32480
Hot gas test results of a miniature free-piston pressurization pump driven by hydrazine decomposition products
| DE91-017072 | N91-32504

**HIGH TEMPERATURE PLASMAS**
Calibration source for electron cyclotron emission measurements
| NIFS-19 | N91-32913

**HIGH TEMPERATURE SUPERCONDUCTORS**
Silver lined ceramic vessel and method of preparation
| AD-D014953 | N91-32224
De Haas van Alphen effect in high temperature superconductors
| DE91-016198 | N91-32397
High temperature superconductivity: The early 1991 edition
| DE91-017655 | N91-32417
Neutron diffraction by the flux lattice in high-Tc superconductors
| DE91-017866 | N91-32418
Neutron scattering from the flux lattice in high temperature superconductors
| DE91-017947 | N91-32419
Oxygen ordered superstructures and domain formation in YBa2Cu3O(7-x)
| DE90-015633 | N91-32958
Irradiation effects in high temperature superconductors
| DE91-016118 | N91-32962
Ion beams in high-temperature superconductivity research
| DE91-016521 | N91-32965
Critical currents in melt-textured YBa2Cu3O(x)
| DE91-016523 | N91-32966
Scaling behavior of the fluctuations in magnetization and conductivity of untwinned YBa2Cu3O(7-delta)
| DE91-016524 | N91-32967
Flux pinning by planar defects in single crystal YBa2Cu3O(7-delta)
| DE91-016525 | N91-32968
Evidence for cation disorder in in-situ grown YBaCuO superconducting films
| DE91-016760 | N91-32971
Magnetically measured irreversibility temperatures in superconducting oxides and alloys
| DE91-016895 | N91-32972
Magnetic relaxation in a single crystal of YBa2Cu3O(x)
| DE91-017963 | N91-32986
Critical currents in sputtered YBCO films
| DE91-017976 | N91-32987
Flux dynamics in high-Tc superconductors
| DE91-017977 | N91-32988
Anisotropy in the a-b plane of normal and superconducting YBa2Cu3O(x)
| DE91-017997 | N91-32989

**HIGH VOLTAGES**
Performance of a 10 kV, 625 kA, 85 kJ energy discharge module utilizing a solid dielectric switch
| DE91-017432 | N91-32409
Discussions on a long gap discharge to an EHV transmission tower by a rocket triggered lightning experiment N91-32654

**HOLDERS**
Ignitability test method and apparatus
| NASA-CASE-LAR-14454-1 | N91-32196

**HOLES (MECHANICS)**
Interlaminar deformations on the cylindrical surface of a hole in laminated composites: An experimental study N91-32172

**HOMOGENEOUS TURBULENCE**
Spectral transfer analysis for subgrid-scale modelling N91-32438

**HONEYCOMB CORES**
Acoustic damping of honeycomb-construction plates by pressure-sensitive adhesives
| NPL-DES-107 | N91-32872

**HOUSINGS**
A simulated lightning effects test facility for testing live and inert missiles and components N91-32725

**HOVERING**
Navier-Stokes analysis for flowfield around hovering rotor N91-32066
Prediction techniques for jet-induced effects in hover on STOVL aircraft
| NASA-TM-102818 | N91-32070

**HUMAN BEHAVIOR**
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms
| DE91-017245 | N91-32774

**HUMAN BEINGS**
Nature and technology: Energy technology, mankind, and nature in the 21st century
| DLR-MITT-91-05 | N91-32581

**HUMAN BODY**
Human analogue models for computer-aided design and engineering applications
| AD-A229520 | N91-32775

**HUMAN FACTORS ENGINEERING**
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
Evaluation of oceanic flight deck workload and error reductions through the use of data communications N91-32128
Human analogue models for computer-aided design and engineering applications
| AD-A229520 | N91-32775
Workshop on NASA workstation technology
| NASA-CR-188866 | N91-32800
An intelligent tutoring system for the investigation of high performance skill acquisition
| NASA-CR-188827 | N91-32827

**HUMAN PERFORMANCE**
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms
| DE91-017245 | N91-32774

**HYBRID CIRCUITS**
Spacecraft power system concerns regarding failure modes within complex integrated circuits and hybrid packages N91-32308
Capability approval programme for Microwave Hybrid Integrated Circuits (MHICS)
| ESA-PSS-01-612-ISSUE-1 | N91-32420
**HYBRID COMPUTERS**
The role of photosensitive polyimides in the development of hybrid space hardware N91-32321
**HYBRID STRUCTURES**
New technologies for integrating thermal control, and radiation protection in hybrid technology N91-32330
**HYDRAZINES**
Hot gas test results of a miniature free-piston pressurization pump driven by hydrazine decomposition products
| DE91-017072 | N91-32504
**HYDRODYNAMICS**
Instability of shaped charged jets with general constitutive equations
| FFI-91/4004 | N91-32203
Simulation of single mode Richtmyer-Meshkov instability using the adaptive free Lagrange method
| DE91-017657 | N91-32457
A two-dimensional dynamic mix model in free Lagrange hydrodynamics
| DE91-017661 | N91-32467
Spline methods for conservation equations
| DE91-017152 | N91-32867
Asymmetries in extragalactic radio sources N91-33050
**HYDROGEN**
The effect of chemical additives on the synthesis of ethanol
| DE91-016586 | N91-32192
Effect of prior mechanical deformation on hydrogen transport through 13 percent chromium martensitic stainless steel
| NPL-DMM(A)-14 | N91-32202
Natural gas conversion process
| DE91-015759 | N91-32235
Performance of a dual anode nickel-hydrogen cell N91-32563
High-intensity photoionization of H2
| DE91-017087 | N91-32885
Radiation-induced attenuation of high-OH optical fibers after hydrogen treatment in the presence of ionizing radiation
| DE91-016093 | N91-32921
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium
| DE91-016161 | N91-32964
**HYDROGEN COMPOUNDS**
Total dose effects in MOS systems: Influence of the initial hydrogen distribution N91-32338
**HYDROGEN OXYGEN FUEL CELLS**
Regenerative fuel cell architectures for lunar surface power N91-32560
**HYDROGEN PRODUCTION**
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
Space water electrolysis: Space Station through advance missions N91-32553
**HYDROGENATION**
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium
| DE91-016161 | N91-32964
**HYDROLOGICAL CYCLE**
WetNet operations N91-32668
**HYDROTHERMAL STRESS ANALYSIS**
Progressive fracture in composites subjected to hygrothermal environment
| NASA-TM-105230 | N91-32182
**HYDROXYL RADICALS**
Investigation of radiative interactions in supersonic internal flows
| NASA-CR-188820 | N91-32078
**HYPERSONIC FLOW**
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034
Parabolized Navier-Stokes methods for hypersonic flows N91-32433
Navier-Stokes flow calculations by an implicit non-centered method N91-32436
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
| NASA-CR-187617 | N91-32441
**HYPERVELOCITY FLOW**
An approximate Riemann solver for hypervelocity flows
| NASA-CR-187629 | N91-32463
**HYSTERESIS**
Basic studies of baroclinic flows N91-32662

## I

**ICE**
On charging of snow particles in blizzard N91-32724
**ICE CLOUDS**
International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects
| NASA-CP-3114 | N91-32528
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537
**IDEAL GAS**
Solution of perfect gas viscous flows via compressible Navier-Stokes equations with wallslip conditions
| ONERA-RSF-13/3637-AY | N91-32435
Navier-Stokes flow calculations by an implicit non-centered method N91-32436
Baryon inhomogeneity from the cosmic quark-hadron phase transition
| DE91-016608 | N91-33051
**IGNEOUS ROCKS**
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada
| NASA-CR-183493 | N91-32591
**IGNITION**
Ignitability test method and apparatus
| NASA-CASE-LAR-14454-1 | N91-32196
Autoignition chemistry of C4 olefins under motored engine conditions: A comparison of experimental and modeling results
| DE91-016511 | N91-32197
Measurements of some parameters of thermal sparks with respect to their ability to ignite aviation fuel/air mixtures N91-32705
**ILLUMINATING**
The internal caustic structure of illuminated liquid droplets
| NASA-CR-187194 | N91-32474
**IMAGE ANALYSIS**
Lightning to the upper atmosphere: A vertical light pulse from the top of a thunderstorm as seen by a payload bay TV camera of the space shuttle N91-32720
Introduction to multiresolution morphology
| IZF-1991-A-10 | N91-32753
Advanced multiresolution morphology
| IZF-1991-A-12 | N91-32812
**IMAGE ENHANCEMENT**
Indirect imaging through the atmosphere
| ESA-TT-1115 | N91-33034
**IMAGE INTENSIFIERS**
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs)
| DE91-016196 | N91-32407
Measurement of modulation transfer function for four types of imaging elements used in fast cameras
| DE91-017399 | N91-32475
**IMAGE PROCESSING**
Analysis of a multiple reception model for processing images from the solid-state imaging camera N91-32259
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs)
| DE91-016196 | N91-32407
Automatic land-use classification using LANDSAT-5 thematic mapper data in a region of the Itzehoer Geest. An attempt to improve mapping by combination with panchromatic SPOT data
| DLR-FB-90-47 | N91-32542
Parametric rectification of thematic mapper raw data
| DLR-FB-90-55 | N91-32543
An analog retina model for detecting moving objects against a moving background
| DE91-017428 | N91-32544
Contour-map encoding of shape for early vision
| NASA-CR-188937 | N91-32545
Generation of topographic terrain models utilizing synthetic aperture radar and surface level data
| NASA-CASE-GSC-13212-1 | N91-32546
Advanced visualization techniques N91-32669
Introduction to multiresolution morphology
| IZF-1991-A-10 | N91-32753
The Cortex Transform as an image preprocessor for sparse distributed memory: An initial study
| NASA-CR-187436 | N91-32798
Advanced multiresolution morphology
| IZF-1991-A-12 | N91-32812
Distortion free projection lithography
| DE91-016570 | N91-32916
Optoelectronic associative memory
| NASA-CASE-NPO-18278-1-CU | N91-32925
**IMAGE RECONSTRUCTION**
Indirect imaging through the atmosphere
| ESA-TT-1115 | N91-33034
**IMAGE RESOLUTION**
Introduction to multiresolution morphology
| IZF-1991-A-10 | N91-32753
Advanced multiresolution morphology
| IZF-1991-A-12 | N91-32812
**IMAGE TUBES**
Measurement of modulation transfer function for four types of imaging elements used in fast cameras
| DE91-017399 | N91-32475
**IMAGES**
Beam optics of the AmPS extraction line
| NIKHEF-K/AMPS/91-01 | N91-32914
**IMAGING TECHNIQUES**
Analysis of a multiple reception model for processing images from the solid-state imaging camera N91-32259
Advanced visualization techniques N91-32669
Introduction to multiresolution morphology
| IZF-1991-A-10 | N91-32753
Advanced multiresolution morphology
| IZF-1991-A-12 | N91-32812
High-energy synchrotron radiation x ray microscopy: Present status and future prospects
| DE91-016894 | N91-32893
Indirect imaging through the atmosphere
| ESA-TT-1115 | N91-33034
**IMMOBILIZATION**
Application and use of spinal immobilization devices in zero-gravity flight N91-32781
**IMPACT DAMAGE**
Materials and processes laboratory composite materials characterization task, part 1. Damage tolerance
| NASA-TM-103553 | N91-32185
Advances in the design of toughened ceramics
| DE91-016767 | N91-32228
Lightning protection of the Fokker 100 CFRP rudder N91-32612
**IMPACT LOADS**
Delaminations in composite plates under transverse static or impact loads N91-32183
**IMPACT TESTS**
Lightning protection of the Fokker 100 CFRP rudder N91-32612
**IMPEDANCE MEASUREMENT**
Impedances of nickel electrodes cycled in various KOH concentrations N91-32557
**IMPLOSIONS**
The promise of magnetized fuel: High gain in inertial confinement fusion
| DE91-016321 | N91-32937
**IMPULSES**
Further identification and treatment modalities in telephone mediated lightning strike N91-32622
**INCLUSIONS**
A literature review of inclusion removal by filtration and flotation
| NPL-DMM(A)-13 | N91-32201
**INCOMPRESSIBLE FLOW**
An incompressible flow solver N91-32040
Numerical simulation of unsteady compressible viscous flows using an implicit upwind relaxation scheme N91-32041
Active control of vortex shedding frequency by a splitter plate N91-32059
Stabilized finite element formulations for incompressible flow computations
| UMSI-91/66 | N91-32431
**INDEXES (DOCUMENTATION)**
The new metals and alloys compilation, a powerful materials analysis tool
| DE91-016199 | N91-32208
**INDIUM ARSENIDES**
An overview of the electronic properties of InAs(1-x)Sb(x) strained-layer superlattices (O less than or equal to x less than or equal to 1)
| DE91-017458 | N91-32976
**INDUSTRIAL SAFETY**
Pressure safety training
| DE91-015717 | N91-32238
Lightning location system supervising Swedish power transmission network N91-32617
**INDUSTRIES**
Krupp Technical Reports, number 2, December 1990 (English version)
| ISSN-0930-9276 | N91-32994
The role of Krupp Forschungsinstitut in international R and D cooperation N91-32996
Know-how for Europe N91-32997
**INELASTIC COLLISIONS**
Reciprocity theory of binary inelastic encounters
| IC-AERO-89-03 | N91-32425

**INELASTIC SCATTERING**
Giant resonances in single and double charge exchange
| DE91-017822 | N91-32900
High energy spin waves in iron measured by neutron scattering
| DE91-017868 | N91-32902
**INELASTIC STRESS**
Fracture characterization for thermoinelasticity N91-32517
**INERTIAL CONFINEMENT FUSION**
Emittance variations in current-amplifying ion induction linacs
| DE91-016266 | N91-32909
The promise of magnetized fuel: High gain in inertial confinement fusion
| DE91-016321 | N91-32937
Intense ion beam diagnostics for light ion inertial fusion experiments on PBFA 2
| DE91-017449 | N91-32942
Inertial Confinement Fusion, Volume 1, Number 2
| DE91-017920 | N91-32951
**INFECTIOUS DISEASES**
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting
| DE91-017545 | N91-32758
**INFORMATION**
Environment, Safety and Health Thesaurus/Dictionary
| DE91-013428 | N91-33012
**INFORMATION FLOW**
Coping with data from Space Station Freedom
| NASA-CR-188885 | N91-33005
**INFORMATION MANAGEMENT**
An overview of the NASA electronic components information management system N91-32369
CPFS: The total information system tool for EEE-parts procurement N91-32379
WetNet operations N91-32668
Defense Logistic Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 1: Agency-wide plan IRM summary information: Agency
| PB91-204529 | N91-33007
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 2: Individual organizational IRM plans: Organizations
| PB91-204537 | N91-33008
Defense Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 3: Information systems/projects/programs/acquisitions: Catalogue
| PB91-204545 | N91-33009
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 4: Reference information: Reference
| PB91-204552 | N91-33010
**INFORMATION PROCESSING (BIOLOGY)**
Contour-map encoding of shape for early vision
| NASA-CR-188937 | N91-32545
Is thinking computable?
| NASA-CR-188859 | N91-32815
**INFORMATION RETRIEVAL**
Identification of essential success factors for an electronic master publication library
| AD-A229624 | N91-33004
**INFORMATION SYSTEMS**
Millimeter wavelength communications applications for the SEI
| NASA-TM-105275 | N91-32287
An overview of the NASA electronic components information management system N91-32369
CPFS: The total information system tool for EEE-parts procurement N91-32379
A plan of NASDA's parts database in the reliability information system N91-32381
Advanced Software Development Workstation Project, phase 3
| NASA-CR-188824 | N91-32828
The use of software metrics to evaluate information systems N91-33003
Defense Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 3: Information systems/projects/programs/acquisitions: Catalogue
| PB91-204545 | N91-33009
**INFORMATION THEORY**
Cognitive cybernetics and human communication: The regulatory effects of prior knowledge N91-32771
NASA/DoD aerospace knowledge diffusion research project: Phase 3 academic library respondents including frequency distributions
| NASA-TM-104095 | N91-33013
**INFORMATION TRANSFER**
NASA/DoD aerospace knowledge diffusion research project: Phase 3 academic library respondents including frequency distributions
| NASA-TM-104095 | N91-33013
**INFRARED ASTRONOMY**
Infrared astronomy N91-33019
SOFIA: A Stratospheric Observatory for Infrared Astronomy
| NASA-TM-103840 | N91-33033
**INFRARED INTERFEROMETERS**
Interferometry N91-33022
**INFRARED RADIATION**
Infrared radiative energy transfer in gaseous systems
| NASA-CR-188925 | N91-32462
Non-invasive pressure measuring device and method
| AD-D014949 | N91-32470
Infrared astronomy N91-33019
**INFRARED SPECTRA**
Infrared astronomy N91-33019
Optical/IR from ground N91-33020
**INHIBITORS**
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root
| DE91-016255 | N91-32749
**INHOMOGENEITY**
Macroscale implicit, electromagnetic particle simulation of inhomogeneous and magnetized plasmas in multi-dimensions
| NIFS-91 | N91-32929
Baryon inhomogeneity from the cosmic quark-hadron phase transition
| DE91-016608 | N91-33051
**INJURIES**
The QT interval in lightning injury with implications for the cessation of metabolism hypothesis N91-32621
Further identification and treatment modalities in telephone mediated lightning strike N91-32622
Assessing the risk of chronic lung injury attributable to long-term ozone exposure
| DE91-016814 | N91-32757
**INLET FLOW**
Supersonic inlet flow computations with cavity N91-32049
Unsteady flowfield of a propfan at takeoff conditions
| NASA-TM-105223 | N91-32075
Nozzle diffuser for use with an open test section of a wind tunnel
| NASA-CASE-LAR-14424-1-SB | N91-32149
**INLET NOZZLES**
Nozzle diffuser for use with an open test section of a wind tunnel
| NASA-CASE-LAR-14424-1-SB | N91-32149
**INLET TEMPERATURE**
Preliminary flight evaluation of an engine performance optimization algorithm
| NASA-TM-4328 | N91-32140
**INPUT/OUTPUT ROUTINES**
Equations of learning and capacity of layered neural networks
| AD-A229633 | N91-32857
**INSERTION LOSS**
Performance of a high T(sub c) superconducting ultra-low loss microwave stripline filter N91-32255
**INSPECTION**
Military robotics technologies at Sandia National Laboratories
| DE91-016113 | N91-32858
**INSTRUMENT LANDING SYSTEMS**
Results of MLS/ILS comparison flight test at the Yuma MCAS, Arizona
| DOT/FAA/CT-TN91/10 | N91-32092
**INTEGRAL EQUATIONS**
An r-matrix approach to nonstandard classes of integrable equations
| MATHS-REPT-A-149 | N91-32861
**INTEGRATED CIRCUITS**
Design and status of the RF-digitizer integrated circuit N91-32262
An evaluation programme for the capability approval of GaAs MMICs N91-32303
A survey of the parasitic effects and degradation mechanisms affecting the GaAs FET-based IC's: The first step for a technological evaluation N91-32304
Spacecraft power system concerns regarding failure modes within complex integrated circuits and hybrid packages N91-32308
Qualification strategy for multi-chip packaging for space applications N91-32312
MTSL-005: Reliability evaluation of high pincount hermetic ceramic packages for space applications N91-32328
Radiation assessment of complex technologies N91-32342
Heavy-ion induced single-event upset in integrated circuits N91-32347
Simulation of radiation induced circuit failure modes in SOS integrated circuits N91-32351
The advantages of silicon-on-insulator technologies for space environments N91-32352
Total dose study on LS-, ALS, and F-technology integrated circuits N91-32354
The merits of an independent pre-cap inspection N91-32378
Design and evaluation of a GaAs MMIC X-band active RC quadrature power divider
| FEL-91-A076 | N91-32396
Processing issues and technologies for optoelectronics-integrated circuits and devices
| DE91-017451 | N91-32406
Capability approval programme for Microwave Hybrid Integrated Circuits (MHICS)
| ESA-PSS-01-612-ISSUE-1 | N91-32420
**INTEGRATED MISSION CONTROL CENTER**
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms
| DE91-017245 | N91-32774
**INTEGRATORS**
Symbol lock detection in the ARX 2 and Block 5 receivers N91-32261
**INTELSAT SATELLITES**
Operational SATCOM: Moving from trials to service N91-32111
**INTERATOMIC FORCES**
X ray absorption fine structure of systems in the anharmonic limit
| DE91-016070 | N91-32892
**INTERFACES**
Theoretical modelling of AFM for bimetallic tip-substrate interactions
| NASA-TM-105280 | N91-32215
Specular and diffuse scattering studies of multilayer interfaces
| DE91-016893 | N91-32978
**INTERFEROMETRY**
Interferometric results from Boeing grazing incidence ring resonator FEL
| DE91-016305 | N91-32484
Thunderstorm monitoring and lightning warning, operational applications of the Safir system N91-32619
A system for mapping sources of VHF and electric field pulses from in-cloud lightning at KSC N91-32697
Interferometry N91-33022
**INTERNAL COMBUSTION ENGINES**
Autoignition chemistry of C4 olefins under motored engine conditions: A comparison of experimental and modeling results
| DE91-016511 | N91-32197
Braun heat pump engine/compressor and its hermetic rod seal
| DE91-017151 | N91-32239
Inherently safe nuclear-driven internal combustion engines
| DE91-016568 | N91-32503
**INTERNATIONAL COOPERATION**
The First Annual International Satellite Surveillance and Communication Symposium
| DOT/FAA/RD-91/21 | N91-32093
Satellite Communications (SATCOM) N91-32095
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
International Civil Aviation Organization (ICAO) Automatic Dependent Surveillance Panel (ADSP) activities N91-32097
International program summary N91-32098
ADS (Automatic Dependent Surveillance) PET (Pacific Engineering Trial) program in Japan N91-32100
Australian experiments in Automatic Dependent Surveillance (ADS) including the Pacific Engineering Trials (PET) N91-32101
EQML: A chance for Europe N91-32383
A comparison of the specifications for standard Electrical, Electronic and Electromechanical (EEE) parts used by the National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA): Towards common specifications N91-32391
Is the ESA/SCC screening technique more efficient than the MIL specifications? N91-32392
Europe 1993: The single European market and R and D policy at Krupp N91-32995
The role of Krupp Forschungsinstitut in international R and D cooperation N91-32996
Know-how for Europe N91-32997
Europe 1993: Challenge and opportunity for distribution logistics N91-32998
Japan-US Liaison Group on Joint Databases Development
| PB91-214056 | N91-33006

A political scenario for Europe: Pan-European security system
[FFI-91/5009] N91-33015
**INTERPLANETARY MAGNETIC FIELDS**
A global simulation of the magnetosphere with a long tail: Southward and northward IMF
[NIFS-99] N91-32592
A study of the magnetosphere-ionosphere coupling processes N91-32595
**INTERPLANETARY NAVIGATION**
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251
**INTERPROCESSOR COMMUNICATION**
Highly parallel computer architecture for robotic computation
[NASA-CASE-NPO-17632-1-CU] N91-32805
Present and future supercomputer network architectures
[DE91-018035] N91-32855
What's happening with supercomputer networks?
[DE91-018036] N91-32856
**INTERSTITIALS**
Mechanisms of defect production and atomic mixing in high energy displacement cascades: A molecular dynamics study
[DE91-017082] N91-32979
**INTRAVENOUS PROCEDURES**
Venipuncture and intravenous infusion access during zero-gravity flight N91-32788
**INVENTIONS**
Non-invasive pressure measuring device and method
[AD-D014949] N91-32470
**INVERSE KINEMATICS**
Distributed memory approaches for robotic neural controllers
[NASA-CR-188865] N91-32859
**INVERSE SCATTERING**
Krylov subspace methods for complex non-Hermitian linear systems
[NASA-CR-188891] N91-32821
**INVISCID FLOW**
Numerical simulation of unsteady compressible viscous flows using an implicit upwind relaxation scheme N91-32041
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441
Calculation of unsteady linearized Euler flows in cascades using harmonically deforming grids
[NASA-CR-188916] N91-32442
**IODIDES**
Optical diagnostics of mercuric iodide crystal growth
[DE91-017396] N91-32983
**ION ACCELERATORS**
The extension of the HHIRF accelerators to produce radioactive ion beams
[DE91-017687] N91-32899
Advanced high brightness ion RF accelerator applications in the nuclear energy
[DE91-016075] N91-32905
**ION BEAMS**
Ion beam sputtering in electric propulsion facilities
[NASA-TM-105145] N91-32158
Tribological behavior of silver films prepared on ceramic surfaces by ion-beam-assisted deposition
[DE91-017306] N91-32505
The extension of the HHIRF accelerators to produce radioactive ion beams
[DE91-017687] N91-32899
Visible spectroscopy diagnostics of light-ion beams
[DE91-017450] N91-32908
Macroscale implicit, electromagnetic particle simulation of inhomogeneous and magnetized plasmas in multi-dimensions
[NIFS-91] N91-32929
Intense ion beam diagnostics for light ion inertial fusion experiments on PBFA 2
[DE91-017449] N91-32942
Ion beams in high-temperature superconductivity research
[DE91-016521] N91-32965
**ION CYCLOTRON RADIATION**
Tuning and matching of the BPX ICH system
[DE91-017872] N91-32950
**ION ENGINES**
Multimegawatt electric propulsion system design considerations
[NASA-TM-105152] N91-32164
Performance enhancement using power beaming for electric propulsion Earth orbital transporters
[DE91-017287] N91-32168
**ION EXCHANGE MEMBRANE ELECTROLYTES**
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
High energy efficiency and high power density proton exchange membrane fuel cells: Electrode kinetics and mass transport N91-32558
Some recent studies with the solid-ionomer electrochemical capacitor N91-32562
**ION IMPLANTATION**
Formation and annealing behavior of an amorphous layer induced by tin implantation into sapphire
[DE91-015929] N91-32960
Ion implantation effects in crystalline quartz
[DE91-016192] N91-32977
**ION IRRADIATION**
Irradiation-induced chromium depletion and its influence on integranular stress corrosion cracking of stainless steels
[DE91-017418] N91-32212
**ION PROPULSION**
Ion beam sputtering in electric propulsion facilities
[NASA-TM-105145] N91-32158
**ION SOURCES**
Inertial Confinement Fusion, Volume 1, Number 2
[DE91-017920] N91-32951
**ION TEMPERATURE**
An H-mode-like bifurcation in core plasma of stellarators
[NIFS-97] N91-32933
**IONIC COLLISIONS**
Ultrarelativistic atomic collisions
[DE91-016768] N91-32884
Atomic and molecular collision processes
[DE91-017649] N91-32897
**IONIZATION CHAMBERS**
Comparison of factors given in ICRU report 23 and IAEA TRS 277 for converting from exposure/air kerma to absorbed dose to water for medium energy x rays
[NPL-RSA(EXT)-15] N91-32147
**IONIZING RADIATION**
Temperature compensation of PMOS dosimeters N91-32336
Radiation-induced attenuation of high-OH optical fibers after hydrogen treatment in the presence of ionizing radiation
[DE91-016093] N91-32921
**IONOSPHERIC PROPAGATION**
Propagation limitations for transionospheric systems from 10 to 300 GHz N91-32243
HF systems operating beneath the ionosphere N91-32244
**IONOSPHERIC STORMS**
A study of the magnetosphere-ionosphere coupling processes N91-32595
**IRON**
High energy spin waves in iron measured by neutron scattering
[DE91-017868] N91-32902
**IRON ALLOYS**
Comparison of high temperature, high frequency core loss and dynamic B-H loops of two 50 Ni-Fe crystalline alloys and an iron-based amorphous alloy
[NASA-TM-105205] N91-32412
X ray dichroism and Faraday effect studies in ordered and disordered Fe3Pt
[DE91-017305] N91-32974
**IRON CHLORIDES**
Sodium-metal chloride battery research at JPL N91-32566
**IRON COMPOUNDS**
X ray absorption fine structure of systems in the anharmonic limit
[DE91-016070] N91-32892
**IRRADIATION**
Irradiation tests and radiation hardness prediction considerations on electronic components for space application N91-32355
Radiation-induced attenuation of high-OH optical fibers after hydrogen treatment in the presence of ionizing radiation
[DE91-016093] N91-32921
Irradiation effects in high temperature superconductors
[DE91-016118] N91-32962
Application of a thermal spike model to experimental ion-induced grain growth data
[DE91-017320] N91-32981
**ISOTHERMS**
User's manual for PANDA 2: A computer code for calculating equations of state
[DE91-017717] N91-32843
**ISOTOPIC LABELING**
Further development of IDGS: Isotope dilution gamma-ray spectrometry
[DE91-016315] N91-32936
**ISOTROPIC TURBULENCE**
Spectral transfer analysis for subgrid-scale modelling N91-32438
**ITERATION**
Numerical simulation of unsteady compressible viscous flows using an implicit upwind relaxation scheme N91-32041
**ITERATIVE SOLUTION**
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components
[NASA-CR-187196] N91-32524
I-BIEM calculations of the frequency dispersion and AC current distribution at disk and ring-disk electrodes N91-32559
An iterative method for obtaining the optimum lightning location on a spherical surface N91-32709
An implementation of the look-ahead Lanczos algorithm for non-Hermitian matrices
[NASA-CR-188889] N91-32820
Krylov subspace methods for complex non-Hermitian linear systems
[NASA-CR-188891] N91-32821
Parallel implementation of a nonsymmetric tridiagonal eigensolver
[DE91-016773] N91-32834
Gaussian elimination methods for calculating classical periodic trajectories in two dimensions
[DE91-017600] N91-32869

## J

**J INTEGRAL**
Load-line displacements for three-point bend J tests using bottom surface displacements
[AD-A229634] N91-32518
**JAMMING**
Propagation Limitations for Systems Using Band-Spreading
[AGARD-LS-172] N91-32241
**JAPAN**
Satellite data link research and development program in Japan N91-32108
Japan-US Liaison Group on Joint Databases Development
[PB91-214056] N91-33006
**JAPANESE SPACE PROGRAM**
A plan of NASDA's parts database in the reliability information system N91-32381
**JET ENGINE FUELS**
Measurements of some parameters of thermal sparks with respect to their ability to ignite aviation fuel/air mixtures N91-32705
**JET ENGINES**
On the maximum range of flying wings
[AD-A229487] N91-32130
**JET LIFT**
Prediction techniques for jet-induced effects in hover on STOVL aircraft
[NASA-TM-102818] N91-32070
**JET PROPULSION**
On the maximum range of flying wings
[AD-A229487] N91-32130
**JET STREAMS (METEOROLOGY)**
South Pacific convergence zone and global scale circulations (Jul. 1987 - Jul. 1991). Observational and modeling studies of heat, moisture, precipitation, and global-scale circulation patterns (Jul. 1990 - Jul. 1993) N91-32691
**JOINTS (JUNCTIONS)**
Adhesive bonding handbook for advanced structural materials
[ESA-PSS-03-210-ISSUE-1] N91-32234
Graphite-metal brazing for thermal applications
[DE91-016647] N91-32944
**JOSEPHSON JUNCTIONS**
Single vortex motion and elementary pinning force in SNIS Josephson junctions
[DE91-016160] N91-32963
**JUPITER ATMOSPHERE**
High resolution measurements of density structures in the Jovian plasma sheet
[NASA-CR-188918] N91-33043

## K

**K-EPSILON TURBULENCE MODEL**
Turbulence model calculations on the effects of body forces on turbulent flows in a pipe N91-32056
Some current approaches in turbulence modelling N91-32446
Computational turbulence studies in Turkey N91-32449
A k-epsilon modeling of near wall turbulence
[NASA-TM-105238] N91-32460
A two-dimensional dynamic mix model in free Lagrange hydrodynamics
[DE91-017661] N91-32467

**KINETIC ENERGY**
Conservation of angular momentum in direct simulation Monte Carlo method N91-32038
An incompressible flow solver N91-32040
Comparison of kinetic, equilibrium, and frozen rocket expansion obtained at different propulsive parameters for launcher and spacecraft engines [DLR-MITT-91-02] N91-32159
**KINETIC THEORY**
A new variational formulation of kinetic plasma theory and the application of moving finite elements [DE91-016072] N91-32938
Kinetic theory of RF current drive and helicity injection [DE91-017388] N91-32946
**KINETICS**
A new approach to the reliability of electronic material systems N91-32310
**KNOWLEDGE**
Cognitive cybernetics and human communication: The regulatory effects of prior knowledge N91-32771
**KNOWLEDGE BASES (ARTIFICIAL INTELLIGENCE)**
IDEF3 and IDEF4 automation system requirements document and system environment models [NASA-CR-188829] N91-32804
Advanced software development workstation project ACCESS user's guide [NASA-CR-188823] N91-32829
A NASA/RAE cooperation in the development of a real-time knowledge-based autopilot [NASA-TM-104234] N91-32850

## L

**LABORATORIES**
Quality assurance of field screening [DE91-016303] N91-32582
Environmental radioactivity measurement intercomparison exercise 1990 [NPL-RSA(EXT)-20] N91-32875
**LABYRINTH**
Assessment of drug effectiveness N91-32768
**LAMINAR FLOW**
Numerical treatment of laminar flow in curved rectangular channels with entrance region N91-32053
Developing laminar flow and heat transfer in orthogonally rotating square ducts N91-32054
Flow and heat transfer in a curved annular pipe N91-32055
Navier-Stokes flow calculations by an implicit non-centered method N91-32436
Fluid handling 2: Surgical applications N91-32790
**LAMINAR HEAT TRANSFER**
Developing laminar flow and heat transfer in orthogonally rotating square ducts N91-32054
Flow and heat transfer in a curved annular pipe N91-32055
Fully developed mixed convection in a horizontal pipe N91-32057
**LAMINATES**
Interlaminar deformations on the cylindrical surface of a hole in laminated composites: An experimental study N91-32172
Matrix-dominated thermoviscoplasticity in fibrous metal-matrix composite materials N91-32173
Effect of lightning strike on bromine intercalated graphite fiber/epoxy composites [NASA-TM-104507] N91-32177
Integrated mechanics for the passive damping of polymer-matrix composites and composite structures [NASA-TM-104346] N91-32181
Failure mechanisms and prediction in advanced composite materials N91-32184
Low-cost 3 kV, triggered, stripline, surface-discharge switch [DE91-016641] N91-32403
Magneto-optical record media [DE91-017838] N91-32476
Computational simulation of high temperature metal matrix composite behavior [NASA-TM-104378] N91-32520
Modeling of electrically thick materials theoretical and experimental aspects N91-32605
**LAND USE**
Automatic land-use classification using LANDSAT-5 thematic mapper data in a region of the Itzehoer Geest. An attempt to improve mapping by combination with panchromatic SPOT data [DLR-FB-90-47] N91-32542
Wind energy potential in the United States considering environmental and land-use exclusions [DE91-017535] N91-32577
**LANGUAGE PROGRAMMING**
A VDM-SL specification for the VI pattern matcher [NPL-DITC-171/91] N91-32808
The language compatible arithmetic standard and Ada [NPL-DITC-173/91] N91-32810
**LANTHANUM**
La(sup 139) NMR and NQR study of the temperature dependent structure of La2CuO4+(delta) [DE91-016201] N91-32959
**LANTHANUM OXIDES**
High temperature superconductivity: The early 1991 edition [DE91-017655] N91-32417
**LARGE SPACE STRUCTURES**
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
**LASER ANEMOMETERS**
Study of flow properties of wet solids using laser induced photo chemical anemometry [DE91-016877] N91-32454
**LASER BEAMS**
Zonal deformable mirror for laser wavefront control [DE91-017085] N91-32483
Coherent-state description of free-electron lasers [DE91-017077] N91-32486
Quantum well, beam deflecting surface emitting lasers [NASA-CASE-NPO-18243-1-CU] N91-32489
A survey of laser lightning rod techniques N91-32645
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy [DE91-016571] N91-32917
**LASER DAMAGE**
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy [DE91-016571] N91-32917
**LASER DRILLING**
Laser processing in power plants [DE91-527088] N91-32488
**LASER HEATING**
Dynamics of surface melting [DE91-016344] N91-32206
Picosecond time-resolved electron diffraction studies of laser heated metals [DE91-016345] N91-32207
Laser heated calcium sulfate TLD plates: Application to radiation mapping N91-32364
**LASER INDUCED FLUORESCENCE**
Laser-based diagnostics for density, temperature, velocity, and dissociation fraction in high temperature hydrogen flows [DE91-016323] N91-32480
**LASER MATERIALS**
Thermal-mechanical and physical-chemical properties of phosphate laser glasses [DE91-016604] N91-32227
Laser processing in power plants [DE91-527088] N91-32488
**LASER OUTPUTS**
Laser performance and optical properties of LiSrGaF6:Cr(3+) [DE91-016555] N91-32481
Laser processing in power plants [DE91-527088] N91-32488
**LASER PLASMAS**
Inertial Confinement Fusion, Volume 1, Number 2 [DE91-017920] N91-32951
**LASER PROPULSION**
System requirements for low-Earth-orbit launch using laser propulsion [DE91-017455] N91-32490
**LASER PUMPING**
Future directions of laboratory x ray laser research [DE91-017088] N91-32487
**LASER RANGE FINDERS**
JPL 1990-3: A 5-nrad extragalactic source catalog based on combined radio interferometric observations N91-32276
Refinement of a pulsed CO2-laser rangefinder with heterodyne detection [FEL-90-A303] N91-32477
**LASER WELDING**
Laser processing in power plants [DE91-527088] N91-32488
Numerical simulation of a laser welding process [DE91-016454] N91-32500
**LASERS**
Spectral filters for laser communications N91-32257
Laser processing in power plants [DE91-527088] N91-32488
System requirements for low-Earth-orbit launch using laser propulsion [DE91-017455] N91-32490
A lidar equipped with photon counter for measuring stratospheric aerosols N91-32540
A survey of laser lightning rod techniques N91-32645
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
**LATCH-UP**
Radiation tolerant 1 micron CMOS technology N91-32335
Single event test method and test results on the Intel 80386 N91-32343
Trends in latch-up sensitivity N91-32345
The pre-screening of large semiconductor memories for space application N91-32357
Total dose characterization of new components for the ESA radiation effects database N91-32362
**LATTICE PARAMETERS**
A new approximate sum rule for bulk alloy properties [NASA-TM-105282] N91-32204
Neutron diffraction by the flux lattice in high-Tc superconductors [DE91-017866] N91-32418
**LAUNCH VEHICLES**
Scale-model charge-transfer technique for measuring enhancement factors N91-32651
The detection of the electric field vertical distribution underneath thundercloud: Principle and applications N91-32653
**LAUNCHING**
System requirements for low-Earth-orbit launch using laser propulsion [DE91-017455] N91-32490
The detection of the electric field vertical distribution underneath thundercloud: Principle and applications N91-32653
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656
**LAUNCHING SITES**
Launch pad lightning protection effectiveness N91-32627
**LEAKAGE**
SOS material improvement for post total dose, radiation induced leakage reduction N91-32353
**LEARNING**
Equations of learning and capacity of layered neural networks [AD-A229633] N91-32857
**LEPTONS**
A pulsed lepton source at LAMPF [DE91-016010] N91-32904
**LIBRARIES**
Identification of essential success factors for an electronic master publication library [AD-A229624] N91-33004
NASA/DoD aerospace knowledge diffusion research project: Phase 3 academic library respondents including frequency distributions [NASA-TM-104095] N91-33013
**LIE GROUPS**
Graph theory and the Virasoro master equation [DE91-016432] N91-32866
**LIFE (DURABILITY)**
Qualification status of hybrid crystal oscillators style OTO 16S for space application N91-32322
Physical and chemical analysis of a Ni/H2 cell N91-32555
**LIFE CYCLE COSTS**
Cost effectiveness of two versus three levels of maintenance for turbine engines in the Air Force inventory [AD-A229622] N91-32137
**LIFE SUPPORT SYSTEMS**
Space water electrolysis: Space Station through advance missions N91-32553
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) N91-32787
**LIFT**
Finite difference numerical prediction of aerodynamics for airfoil flying over wavy wall N91-32043
**LIGANDS**
Multiheteromacrocycles that complex metal ions [DE91-016292] N91-32205
**LIGHT (VISIBLE RADIATION)**
In situ measurements of light extinction of stratospheric aerosols N91-32541
**LIGHT ALLOYS**
Hanover University research report [ISSN-0723-1903] N91-33052
**LIGHT BEAMS**
Coherent hard x ray focusing optics and applications [DE91-017968] N91-32928
**LIGHT CURVE**
Vertical mixing and methane photochemistry in the atmosphere of Uranus: Analysis of Voyager UVS occultation experiments [NASA-CR-188789] N91-33042

**LIGHT ELEMENTS**
Testing the big bang: Light elements, neutrinos, dark matter, and large-scale structure
[DE91-017379] N91-33040
**LIGHT IONS**
Visible spectroscopy diagnostics of light-ion beams
[DE91-017450] N91-32908
Intense ion beam diagnostics for light ion inertial fusion experiments on PBFA 2
[DE91-017449] N91-32942
**LIGHT MODULATION**
Optoelectronic associative memory
[NASA-CASE-NPO-18278-1-CU] N91-32925
**LIGHT SCATTERING**
Circular Intensity Differential Scattering (CIDS) measurements in the soft x ray region of the spectrum (approximately 16 eV to 500 eV)
[DE91-016429] N91-32915
**LIGHT TRANSMISSION**
Processing issues and technologies for optoelectronics-integrated circuits and devices
[DE91-017451] N91-32406
**LIGHTNING**
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1
[NASA-CP-3106-VOL-1] N91-32599
Lightning threat to aircraft: Do we know all we need to know? N91-32600
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601
Intracloud development of lightning strikes to aircraft N91-32602
Current wave-form observed during lightning strikes on aircraft N91-32603
Lightning current rate of rise in the new lightning flash model for the space shuttle program N91-32604
Investigations into the damage for various types of unprotected carbon fibre composites with a variety of lightning arc attachments N91-32606
Characteristics of winter lightning currents struck an isolated tower N91-32607
Thunderstorm detection and warning system atmospheric potential monitor N91-32608
E and DE/DT waveshapes for narrow bipolar pulses in intracloud lightning N91-32610
The performance of cable braids and terminations to lightning induced transients N91-32611
Lightning protection of the Fokker 100 CFRP rudder N91-32612
Protection of electrical and electronic equipment against lightning indirect effects on the Airbus A340 wing N91-32613
First and subsequent return stroke properties of cloud-to-ground lightning N91-32614
Characteristics of return stroke electric fields produced by lightning flashes at distances of 1 to 15 kilometers N91-32615
Lightning location system supervising Swedish power transmission network N91-32617
Range estimation techniques in single-station thunderstorm warning sensors based upon gated, wideband, magnetic direction finder technology N91-32618
Thunderstorm monitoring and lightning warning, operational applications of the Safir system N91-32619
The QT interval in lightning injury with implications for the cessation of metabolism hypothesis N91-32621
Further identification and treatment modalities in telephone mediated lightning strike N91-32622
Step voltage analysis for the catenoid lightning protection system N91-32623
Hardening communication ports for survival in electrical overstress environments N91-32624
Launch pad lightning protection effectiveness N91-32627
Activation of the Navy's indirect effects lightning simulation laboratory N91-32628
Characterization of vertical electric fields and associated voltages induced on a overhead power line from close artificially initiated lightning N91-32629
Lightning protection for shuttle propulsion elements N91-32630
Influence of configuration effects on multiple burst simulation testing N91-32631
Evaluation of the damages caused by lightning current flowing through bearings N91-32632
A transportable 50 kA dual mode lightning simulator N91-32633
Mathematical models for determining the protected spaces of the vertical lightning rod N91-32634
Designs for surge immunity in critical electronic facilities N91-32635
The Sandia transportable triggered lightning instrumentation facility N91-32636
The electromagnetic environment in CFC structures N91-32638
A new approach to equipment testing N91-32639
Damage to metallic samples produced by measured lightning currents N91-32640
An assessment of tailoring of lightning protection design requirements for a composite wing structure on a metallic aircraft N91-32641
Lightning protection of full authority digital electronic systems N91-32643
Simulation and measurement of melting effects on metal sheets caused by direct lightning strikes N91-32644
A survey of laser lightning rod techniques N91-32645
Predicting cloud-to-ground lightning with neural networks N91-32646
The electric field change caused by a ground flash with multiple channels N91-32647
FD-TD numerical simulation of an entire lightning strike on the C160 aircraft N91-32648
Observations of bi-directional leader development in a triggered lightning flash N91-32649
Application of surface electrical discharges to the study of lightning strikes on aircraft N91-32650
Scale-model charge-transfer technique for measuring enhancement factors N91-32651
The electric field changes and UHF radiations caused by the triggered lightning in Japan N91-32652
Discussions on a long gap discharge to an EHV transmission tower by a rocket triggered lightning experiment N91-32654
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656
Power and energy dissipation in subsequent return strokes as predicted by a new return stroke model N91-32657
Horizontal fields generated by return strokes N91-32658
Global lightning studies N91-32667
Electrification in winter storms and the analysis of thunderstorm overflight N91-32678
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 2
[NASA-CP-3106-VOL-2] N91-32693
Lightning induced currents in aircraft wiring using low level injection techniques N91-32694
Observations of lightning processes using VHF radio interferometry N91-32695
The physics of the oscillating lightning N91-32696
A system for mapping sources of VHF and electric field pulses from in-cloud lightning at KSC N91-32697
A new approach to the determination of the striking distance from the lightning channel photos N91-32698
A real scale simulator for high frequency LEMP N91-32700
A theoretical analysis of the electromagnetic environment of the AS330 super Puma helicopter external and internal coupling N91-32701
Three-dimensional time domain model of lightning including corona effects N91-32702
Surface wind convergence as a short-term predictor of cloud-to-ground lightning at Kennedy Space Center: A four-year summary and evaluation N91-32703
Assessment and forecasting of lightning potential and its effect on launch operations at Cape Canaveral Air Force Station and John F. Kennedy Space Center N91-32704
The effect of the Earth's oblate spheroid shape on the accuracy of a time-of-arrival lightning ground strike locating system N91-32706
Experience gained in operation of the VLF ATD lightning location system N91-32707
Extension of and improvements to the ERDC low frequency magnetic direction finding system N91-32708
An iterative method for obtaining the optimum lightning location on a spherical surface N91-32709
Comparison of lightning location data and polarisation radar observations of clouds N91-32710
The spatial variations of lightning during small Florida thunderstorms N91-32711
Weak positive cloud-to-ground flashes in Northeastern Colorado N91-32712
Lightning mapping system N91-32713
Lightning testing at the subsystem level N91-32714
Implementation of the FAA research and development electromagnetic database N91-32715
The new Section 23 of DO160C/ED14C lightning testing of externally mounted electrical equipment N91-32716
Design of lightning protection for a full-authority digital engine control N91-32717
Certification of lightning protection for a full-authority digital engine control N91-32718
On error sources during airborne measurements of the ambient electric field N91-32719
Lightning to the upper atmosphere: A vertical light pulse from the top of a thunderstorm as seen by a payload bay TV camera of the space shuttle N91-32720
Optimal parameters of leader development in lightning N91-32723
A simulated lightning effects test facility for testing live and inert missiles and components N91-32725
Experimental modelling of lightning interaction phenomena with a free potential conducting objects N91-32729
Diffuse dispersive delay and the time convolution/attenuation of transients N91-32730
Advances in lightning protection that satisfies contemporary standards N91-32731
Evaluating lightning hazards to building environments using explicit numerical solutions of Maxwell's equations N91-32733
Voltages induced on a power distribution line by overhead cloud lightning N91-32734
Guidelines for a proposed lightning protection policy of a golf association or tournament sponsor N91-32735
Influence of channel base current and varying return stroke speed on the calculated fields of three important return stroke models N91-32736
High current pulse testing for ground rod integrity N91-32737
**LIGHTNING SUPPRESSION**
Effect of lightning strike on bromine intercalated graphite fiber/epoxy composites
[NASA-TM-104507] N91-32177
Electromagnetic emissions from an electro-impulse deicing system in a composite wing equipped with lightning protection
[DOT/FAA/CT-TN90/32] N91-32284
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1
[NASA-CP-3106-VOL-1] N91-32599
Lightning threat to aircraft: Do we know all we need to know? N91-32600
Lightning current rate of rise in the new lightning flash model for the space shuttle program N91-32604
Lightning protection of the Fokker 100 CFRP rudder N91-32612
Protection of electrical and electronic equipment against lightning indirect effects on the Airbus A340 wing N91-32613
Lightning protection for shuttle propulsion elements N91-32630
Influence of configuration effects on multiple burst simulation testing N91-32631
Mathematical models for determining the protected spaces of the vertical lightning rod N91-32634
Designs for surge immunity in critical electronic facilities N91-32635
An assessment of tailoring of lightning protection design requirements for a composite wing structure on a metallic aircraft N91-32641
Lightning protection design and testing of an all composite wet wing for the Egrett N91-32642
Lightning protection of full authority digital electronic systems N91-32643
Lightning testing at the subsystem level N91-32714
The new Section 23 of DO160C/ED14C lightning testing of externally mounted electrical equipment N91-32716
Design of lightning protection for a full-authority digital engine control N91-32717
**LIMITERS (FUSION REACTORS)**
Heat deposition on the partial limiter
[NIFS-28] N91-32954
**LINEAR ACCELERATORS**
Design criteria for a magnetic switch when used to discharge a pulse forming line
[DE91-016559] N91-32402
Applications of synchroscan and dual-sweep streak camera techniques to free-electron laser experiments
[DE91-016017] N91-32479
A pulsed lepton source at LAMPF
[DE91-016010] N91-32904
Advanced high brightness ion RF accelerator applications in the nuclear energy
[DE91-016075] N91-32905
Emittance variations in current-amplifying ion induction linacs
[DE91-016266] N91-32909
**LINEAR ENERGY TRANSFER (LET)**
Single event effects by protons on low Earth orbits: A problem for European manned space missions N91-32349
**LINEAR EQUATIONS**
A general analysis of two-dimensional convection schemes N91-32428
Calculation of unsteady linearized Euler flows in cascades using harmonically deforming grids
[NASA-CR-188916] N91-32442
On polynomial preconditioning for indefinite Hermitian matrices
[NASA-CR-188857] N91-32814

**LINEAR SYSTEMS**
QMR: A Quasi-Minimal Residual method for non-Hermitian linear systems
[NASA-CR-188882] N91-32818
Krylov subspace methods for complex non-Hermitian linear systems
[NASA-CR-188891] N91-32821
**LINEAR TRANSFORMATIONS**
Automatic blocking of nested loops
[NASA-CR-188874] N91-32844
**LINEARITY**
The essential linearity of thermal radiation net transport
[DE91-016734] N91-32990
**LIQUID ALLOYS**
Interaction of InGa liquid alloy coolant with gold coated optical materials
[DE91-017480] N91-32927
**LIQUID CHROMATOGRAPHY**
Sampling of atmospheric carbonyl compounds for determination by liquid chromatography after 2,4-dinitrophenylhydrazine labelling
[DE91-015842] N91-32585
**LIQUID CRYSTALS**
Bifurcations and patterns in non-linear dissipative systems
[DE91-017402] N91-32984
**LIQUID FLOW**
Numerical analysis of bubbly liquid in convergent-divergent nozzle N91-32052
Fundamental metallurgical considerations in brazing and soldering
[DE91-016224] N91-32209
Study of flow properties of wet solids using laser induced photo chemical anemometry
[DE91-016877] N91-32454
**LIQUID HYDROGEN**
Microgravity liquid propellant management
[NASA-CR-184238] N91-32236
**LIQUID METALS**
Fundamental metallurgical considerations in brazing and soldering
[DE91-016224] N91-32209
**LIQUID NITROGEN**
Cryogenic Orbital Nitrogen Experiment (CONE): Phase A/B design study
[NASA-CR-187230] N91-32166
**LIQUID PHASES**
User's manual for PANDA 2: A computer code for calculating equations of state
[DE91-017717] N91-32843
**LIQUID ROCKET PROPELLANTS**
Microgravity liquid propellant management
[NASA-CR-184238] N91-32236
**LIQUIDS**
Equations of state for solid NaCl-KCl and liquid NaCl-KCl-H2O
[DE91-016980] N91-32195
Precision metering of microliter volumes of biological fluids in micro-gravity N91-32792
Liquid and solid Ga and Bi studies with a variable energy positron beam
[DE91-016910] N91-32889
**LITHIUM**
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551
**LITHIUM ALLOYS**
The role of anodic dissolution in the stress corrosion cracking of Al-Li-Cu alloy 2090
[DE91-016403] N91-32219
**LITHIUM SULFUR BATTERIES**
Current status of solid-state lithium batteries employing solid redox polymerization cathodes
[DE91-016988] N91-32404
Advances in Li-TiS2 cell technology N91-32567
**LITHOGRAPHY**
Ion clearing and photoelectron production in the 200 MeV SXLS ring
[DE91-017156] N91-32907
Distortion free projection lithography
[DE91-016570] N91-32916
Wafer cost analysis for a soft x ray projection lithography system
[DE91-016605] N91-32918
**LOAD DISTRIBUTION (FORCES)**
Fracture characterization for thermoinelasticity N91-32517
**LOADS (FORCES)**
Effect of initial conditions on combustion generated loads
[DE91-016646] N91-32194
Uncertainties in stress analysis on marine structures
[PB91-193441] N91-32522
**LOCAL AREA NETWORKS**
Examinations of the rational utilization of the Global Positioning System (GPS) in local networks
[SER-C-361] N91-32129
**LOCOMOTION**
Signs and symptoms of motion sickness and its basic nature N91-32760
**LOGIC CIRCUITS**
Evaluation of FPGAs N91-32361
**LOGICAL ELEMENTS**
Evaluation of FPGAs N91-32361
**LOGISTICS**
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 2: Individual organizational IRM plans: Organizations
[PB91-204537] N91-33008
Defense Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 3: Information systems/projects/programs/acquisitions: Catalogue
[PB91-204545] N91-33009
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 4: Reference information: Reference
[PB91-204552] N91-33010
**LOGISTICS MANAGEMENT**
Europe 1993: Challenge and opportunity for distribution logistics N91-32998
**LONG DURATION EXPOSURE FACILITY**
Measurements of induced radioactivity in some LDEF samples
[DE91-016309] N91-32882
**LOSSES**
Performance of a high T(sub c) superconducting ultra-low loss microwave stripline filter N91-32255
Comparison of high temperature, high frequency core loss and dynamic B-H loops of two 50 Ni-Fe crystalline alloys and an iron-based amorphous alloy
[NASA-TM-105205] N91-32412
**LOW CARBON STEELS**
Development of a spray-forming process for steel
[DE91-015812] N91-32218
**LOW COST**
Low-cost 3 kV, triggered, stripline, surface-discharge switch
[DE91-016641] N91-32403
**LOW FREQUENCIES**
Extension of and improvements to the ERDC low frequency magnetic direction finding system N91-32708
**LOW NOISE**
An approximate HSPICE model for orbit low noise analog bipolar NPN transistors
[DE91-017220] N91-32414
**LUBRICATION**
Lubrication with sputtered MoS2 films: Principles, operation, limitations
[NASA-TM-105292] N91-32216
**LUMINAIRES**
Non-invasive pressure measuring device and method
[AD-D014949] N91-32470
**LUMINESCENCE**
The application of time-resolved luminescence spectroscopy to a remote uranyl sensor
[DE91-016310] N91-32189
**LUNAR ATMOSPHERE**
Mining technology for lunar resource utilization
[PB91-201020] N91-33044
**LUNAR MINING**
Mining technology for lunar resource utilization
[PB91-201020] N91-33044
**LUNAR RESOURCES**
Electrolytic production of oxygen from lunar resources N91-32550
Mining technology for lunar resource utilization
[PB91-201020] N91-33044
**LUNAR SOIL**
Electrolytic production of oxygen from lunar resources N91-32550
Mining technology for lunar resource utilization
[PB91-201020] N91-33044
**LUNAR SURFACE**
Mining technology for lunar resource utilization
[PB91-201020] N91-33044
**LUNGS**
Assessing the risk of chronic lung injury attributable to long-term ozone exposure
[DE91-016814] N91-32757

# M

**MACH NUMBER**
Thin layer Navier-Stokes solutions for transonic multibody interference
[AD-A234252] N91-32072
**MACHINE LEARNING**
Is thinking computable?
[NASA-CR-188859] N91-32815
Machine learning research 1989-90
[NASA-CR-188828] N91-32826
Learning-logic: Casting the cortex of the human brain in silicon
[MIT-TR-47] N91-32840
**MAGNESIUM OXIDES**
New directions for the catalytic conversion of methane
[PB91-206417] N91-32191
**MAGNETIC CIRCUITS**
Reliable, high repetition rate thyratron grid driver used with a magnetic modulator
[DE91-016558] N91-32413
High average power magnetic modulator for copper lasers
[DE91-016560] N91-32482
**MAGNETIC COMPRESSION**
Reliable, high repetition rate thyratron grid driver used with a magnetic modulator
[DE91-016558] N91-32413
**MAGNETIC DISKS**
Non volatile solid state magnetic memory technologies N91-32294
**MAGNETIC ENERGY STORAGE**
Benefit/cost comparison for utility SMES applications
[DE91-017425] N91-32408
**MAGNETIC FIELD CONFIGURATIONS**
Beam-driven currents in the 1/nu regime in a helical system
[NIFS-27] N91-32955
**MAGNETIC FIELD RECONNECTION**
A global simulation of the magnetosphere with a long tail: Southward and northward IMF
[NIFS-99] N91-32592
**MAGNETIC FIELDS**
Reliable, high repetition rate thyratron grid driver used with a magnetic modulator
[DE91-016558] N91-32413
Neutron scattering from the flux lattice in high temperature superconductors
[DE91-017947] N91-32419
Resistive gate magnetic field sensor
[AD-D014952] N91-32471
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601
Extension of and improvements to the ERDC low frequency magnetic direction finding system N91-32708
An iterative method for obtaining the optimum lightning location on a spherical surface N91-32709
Comparison of lightning location data and polarisation radar observations of clouds N91-32710
Weak positive cloud-to-ground flashes in Northeastern Colorado N91-32712
Voltages induced on a power distribution line by overhead cloud lightning N91-32734
Soft x ray magnetic scattering study of thin films and multilayers
[DE91-017472] N91-32920
Macroscale implicit, electromagnetic particle simulation of inhomogeneous and magnetized plasmas in multi-dimensions
[NIFS-91] N91-32929
H-mode physics: Experimental observations and model theories. Lecture notes
[NIFS-92] N91-32930
Flux pinning by planar defects in single crystal YBa2Cu3O(7-delta)
[DE91-016525] N91-32968
Magnetically measured irreversibility temperatures in superconducting oxides and alloys
[DE91-016895] N91-32972
Critical currents in sputtered YBCO films
[DE91-017976] N91-32987
**MAGNETIC FILMS**
Magneto-optical record media
[DE91-017838] N91-32476
**MAGNETIC FLUX**
The electric field change caused by a ground flash with multiple channels N91-32647
Flux dynamics in high-Tc superconductors
[DE91-017977] N91-32988
**MAGNETIC INDUCTION**
A magneto-sensitive skin for robots in space
[NASA-CR-188956] N91-32512

Alleviation of interferences and reduction of sample memory in inductively coupled plasma mass spectrometry
[DE91-016399] N91-32943

**MAGNETIC MATERIALS**
Comparison of high temperature, high frequency core loss and dynamic B-H loops of two 50 Ni-Fe crystalline alloys and an iron-based amorphous alloy
[NASA-TM-105205] N91-32412

**MAGNETIC MEASUREMENT**
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601

**MAGNETIC MOMENTS**
The effect of a neutrino magnetic moment on nuclear excitation processes
[RAL-91-010] N91-32876
Magnetically measured irreversibility temperatures in superconducting oxides and alloys
[DE91-016895] N91-32972

**MAGNETIC PERMEABILITY**
Anisotropy in the a-b plane of normal and superconducting YBa2Cu3O(x)
[DE91-017997] N91-32989

**MAGNETIC RECORDING**
Magneto-optical record media
[DE91-017838] N91-32476

**MAGNETIC RELAXATION**
Magnetic relaxation of the organic superconductor kappa-(BEDT-TTF)2Cu(N(CN)2)Br
[DE91-016528] N91-32969
Magnetic relaxation in a single crystal of YBa2Cu3O(x)
[DE91-017963] N91-32986

**MAGNETIC RESONANCE**
The role of spin chemistry in the primary events of photosynthesis
[DE91-017301] N91-32752
Fast neutron dosimetry
[DE91-016907] N91-32894
Soft x ray magnetic scattering study of thin films and multilayers
[DE91-017472] N91-32920

**MAGNETIC SWITCHING**
Design criteria for a magnetic switch when used to discharge a pulse forming line
[DE91-016559] N91-32402

**MAGNETIC VARIATIONS**
Scaling behavior of the fluctuations in magnetization and conductivity $c^4$ untwinned YBa2Cu3O(7-delta)
[DE91-016524] N91-32967

**MAGNETIZATION**
The promise of magnetized fuel: High gain in inertial confinement fusion
[DE91-016321] N91-32937
Scaling behavior of the fluctuations in magnetization and conductivity of untwinned YBa2Cu3O(7-delta)
[DE91-016524] N91-32967
Magnetically measured irreversibility temperatures in superconducting oxides and alloys
[DE91-016895] N91-32972
Flux dynamics in high-Tc superconductors
[DE91-017977] N91-32988

**MAGNETO-OPTICS**
Magneto-optical record media
[DE91-017838] N91-32476

**MAGNETOHYDRODYNAMIC FLOW**
High resolution measurements of density structures in the Jovian plasma sheet
[NASA-CR-188918] N91-33043

**MAGNETOHYDRODYNAMIC GENERATORS**
Corrosion and arc erosion in MHD channels
[DE91-016829] N91-32939

**MAGNETOHYDRODYNAMIC STABILITY**
Macroscale implicit, electromagnetic particle simulation of inhomogeneous and magnetized plasmas in multi-dimensions
[NIFS-91] N91-32929
ELMy-H mode as limit cycle and chaotic oscillations in tokamak plasmas
[NIFS-96] N91-32932
Axial pressure profile effects on flute interchange stability in the tandem mirror GAMMA 10
[NIFS-98] N91-32934

**MAGNETOHYDRODYNAMICS**
Performance enhancement using power beaming for electric propulsion Earth orbital transporters
[DE91-017287] N91-32168
A global simulation of the magnetosphere with a long tail: Southward and northward IMF
[NIFS-99] N91-32592

**MAGNETOPAUSE**
A global simulation of the magnetosphere with a long tail: Southward and northward IMF
[NIFS-99] N91-32592

**MAGNETOPLASMADYNAMICS**
MPD thruster technology
[NASA-TM-105242] N91-32162

**MAGNETOSPHERE-IONOSPHERE COUPLING**
A study of the magnetosphere-ionosphere coupling processes N91-32595

**MAGNETRONS**
Fabrication of advanced x ray optics with magnetron mini-source arrays
[DE91-017093] N91-32919

**MAINTENANCE**
Cost effectiveness of two versus three levels of maintenance for turbine engines in the Air Force inventory
[AD-A229622] N91-32137
The repair and modification of printed-circuit board assemblies for space use
[ESA-PSS-01-728-ISSUE-2] N91-32422

**MAN ENVIRONMENT INTERACTIONS**
Finiteness: On constraints of applied research
[DLR-MITT-91-06] N91-33001

**MAN MACHINE SYSTEMS**
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
Military robotics technologies at Sandia National Laboratories
[DE91-016113] N91-32858

**MAN-COMPUTER INTERFACE**
Interactive access and management for four-dimensional environmental data sets using McIDAS N91-32670
Workshop on NASA workstation technology
[NASA-CR-188866] N91-32800
An intelligent tutoring system for the investigation of high performance skill acquisition
[NASA-CR-188827] N91-32827
GOOSE: A Generalized Object-Oriented Simulation Environment
[DE91-016771] N91-32842

**MANAGEMENT METHODS**
Beyond formalism
[NASA-CR-188886] N91-32819

**MANAGEMENT PLANNING**
Federal radionavigation plan, 1990
[PB91-190868] N91-32091
Rationales for the selection of a parts procurement system (coordinated versus centralized) from a prime contractor point of view N91-32371
Defense Logistic Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 1: Agency-wide plan IRM summary information: Agency
[PB91-204529] N91-33007
Defense Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 3: Information systems/projects/programs/acquisitions: Catalogue
[PB91-204545] N91-33009
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 4: Reference information: Reference
[PB91-204552] N91-33010
The decade of discovery in astronomy and astrophysics
[NASA-CR-188226] N91-33016

**MANEUVERABILITY**
Development and evaluation of an inverse solution technique for studying helicopter maneuverability and agility
[NASA-TM-102889] N91-32145

**MANGANESE ISOTOPES**
Measurements of induced radioactivity in some LDEF samples
[DE91-016309] N91-32882

**MANIPULATORS**
A unified motion planning approach for redundant and nonredundant manipulators with actuator constraints N91-32494
Application of telerobotic control to remote processing of nuclear material
[DE91-016562] N91-32501
A reference model dynamics-CMAC algorithm for simulation and control of robotic manipulators N91-32507
Telerobot control system
[NASA-CASE-NPO-18116-1-CU] N91-32509
A generalized compliant motion primitive
[NASA-CASE-NPO-18134-1-CU] N91-32510
Development of a sensor coordinated kinematic model for neural network controller training
[NASA-CR-188864] N91-32799
Distributed memory approaches for robotic neural controllers
[NASA-CR-188865] N91-32859

**MANNED MARS MISSIONS**
Multimegawatt electric propulsion system design considerations
[NASA-TM-105152] N91-32164

**MANNED SPACECRAFT**
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251

**MANUFACTURING**
Design and manufacture of space ASICs today and tomorrow: Promises and problems N91-32299
Digital ASIC design for space applications N91-32300
Space silicon diodes: A survey of available technologies and related manufacturing and reliability aspects N91-32320
Manufacture of containers from an oriented biopolymer N91-32999

**MANY BODY PROBLEM**
Thin layer Navier-Stokes solutions for transonic multibody interference
[AD-A234252] N91-32072
Coherent-state description of free-electron lasers
[DE91-017077] N91-32486

**MAPPING**
Laser heated calcium sulfate TLD plates: Application to radiation mapping N91-32364
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada
[NASA-CR-183493] N91-32591
MAMS: High resolution atmospheric moisture/surface properties N91-32664
Lightning mapping system N91-32713

**MARINE TECHNOLOGY**
Uncertainties in stress analysis on marine structures
[PB91-193441] N91-32522

**MARITIME SATELLITES**
INMARSAT access approval N91-32110

**MARKET RESEARCH**
Europe 1993: The single European market and R and D policy at Krupp N91-32995

**MARS (PLANET)**
A nuclear thermal rocket engine design based on the particle bed reactor suitable for a Mars mission
[DE91-016898] N91-32160

**MARS ATMOSPHERE**
Additions to Mars Global Reference Atmospheric Model (Mars-GRAM)
[NASA-CR-188924] N91-33045
Solar radiation on Mars: Update 1991
[NASA-TM-105216] N91-33046

**MARS SURFACE**
Additions to Mars Global Reference Atmospheric Model (Mars-GRAM)
[NASA-CR-188924] N91-33045
Solar radiation on Mars: Update 1991
[NASA-TM-105216] N91-33046

**MARTENSITIC STAINLESS STEELS**
Effect of prior mechanical deformation on hydrogen transport through 13 percent chromium martensitic stainless steel
[NPL-DMM(A)-14] N91-32202

**MARTENSITIC TRANSFORMATION**
Analytical and numerical studies of fracture and fatigue in ceramic materials N91-32516

**MASS DISTRIBUTION**
Thermodynamics of combustion in an enclosure
[DE91-016430] N91-32992

**MASS SPECTROSCOPY**
Versatile, low-cost, computer-controlled, sample positioning system for vacuum applications
[NASA-CR-187144] N91-32237
Further development of IDGS: Isotope dilution gamma-ray spectrometry
[DE91-016315] N91-32936
Alleviation of interferences and reduction of sample memory in inductively coupled plasma mass spectrometry
[DE91-016399] N91-32943
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium
[DE91-016161] N91-32964

**MASS TRANSFER**
High energy efficiency and high power density proton exchange membrane fuel cells: Electrode kinetics and mass transport N91-32558
Helium isotopic constraints on terrestrial degassing and the transcrustal transport of mantle methane
[PB91-206458] N91-32594

**MASSIVELY PARALLEL PROCESSORS**
An assessment of the connection machine
[NASA-CR-188876] N91-32801

A biconjugate gradient type algorithm on massively parallel architectures
[NASA-CR-188888] N91-32848
Empirical results of a hybrid Monte Carlo method for the solution of Poisson's equation
[DE91-016240] N91-32863
Mapping unstructured grid problems to the connection machine
[NASA-CR-187719] N91-32864

**MATERIALS TESTS**
Materials compatibility issues for fabric composite radiators
[DE91-017556] N91-32186
Materials qualification technology for ceramic cross-flow filters
[DE91-017715] N91-32232

**MATHEMATICAL MODELS**
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034
An incompressible flow solver N91-32040
A comparison of the analytical and experimental performance of the solid version of a cooled radial turbine
[NASA-CR-187195] N91-32077
Flight mechanical model for performance calculations and interactions between flight vehicle and ramjet in regard to the flight orbit
[DLR-FB-91-03] N91-32131
Aeroelastic loads and stability investigation of a full-scale hingeless rotor
[NASA-TM-103867] N91-32134
Cost effectiveness of two versus three levels of maintenance for turbine engines in the Air Force inventory
[AD-A229622] N91-32137
Thermodynamic flow description of a ramjet for determination of engine forces and moments
[DLR-FB-91-02] N91-32139
Development and evaluation of an inverse solution technique for studying helicopter maneuverability and agility
[NASA-TM-102889] N91-32145
Optimal control problems with switching points
[NASA-CR-4393] N91-32155
RV strings of maximum curvature
[DE91-016708] N91-32157
Cryogenic Orbital Nitrogen Experiment (CONE): Phase A/B design study
[NASA-CR-187230] N91-32166
Effect of initial conditions on combustion generated loads
[DE91-016646] N91-32194
Autoignition chemistry of C4 olefins under motored engine conditions: A comparison of experimental and modeling results
[DE91-016511] N91-32197
Theoretical modelling of AFM for bimetallic tip-substrate interactions
[NASA-TM-105280] N91-32215
Analysis of a multiple reception model for processing images from the solid-state imaging camera N91-32259
Modeling and simulations of the DSS 13 antenna control system N91-32268
Modeling preparation costs for space missions by using major cost drivers N91-32279
Wideband HF noise/interference modeling, part 1. First-order statistics. Technical memorandum series
[PB91-208454] N91-32281
Multi-dimensional modulation codes for fading channel
[NASA-CR-188959] N91-32288
Modeling and analysis of spacecraft battery charger systems N91-32411
Computational Fluid Dynamics
[VKI-LS-1991-01] N91-32426
A general analysis of two-dimensional convection schemes N91-32428
Upwind methods and multidimensional splittings for the Euler equations N91-32429
Fluctuation splitting schemes for the 2D Euler equations N91-32430
Stabilized finite element formulations for incompressible flow computations
[UMSI-91/66] N91-32431
Channel flow of a concentrated suspension
[DE91-016649] N91-32453
A two-dimensional dynamic mix model in free Lagrange hydrodynamics
[DE91-017661] N91-32467
Numerical simulation of a laser welding process
[DE91-016454] N91-32500
Inherently safe nuclear-driven internal combustion engines
[DE91-016568] N91-32503
Uncertainties in stress analysis on marine structures
[PB91-193441] N91-32522
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525
Integrated compensation of geodetic nets in point masses model
[SER-C-362] N91-32547
Modeling water content effects in polymer electrolyte fuel cells
[DE91-016027] N91-32573
A study of the magnetosphere-ionosphere coupling processes N91-32595
Modeling of electrically thick materials theoretical and experimental aspects N91-32605
Mathematical models for determining the protected spaces of the vertical lightning rod N91-32634
Power and energy dissipation in subsequent return strokes as predicted by a new return stroke model N91-32657
Nonlinear feedbacks between stratocumulus and synoptic-scale systems N91-32674
Laboratory and theoretical models of planetary-scale instabilities and waves N91-32675
Computer modeling of pulsed CO2 lasers for lidar applications N91-32680
A new approach to the determination of the striking distance from the lightning channel photos N91-32698
A theoretical analysis of the electromagnetic environment of the AS330 super Puma helicopter external and internal coupling N91-32701
Three-dimensional time domain model of lightning including corona effects N91-32702
Electron distribution functions in electric field environments N91-32726
Experimental modelling of lightning interaction phenomena with a free potential conducting objects N91-32729
Influence of channel base current and varying return stroke speed on the calculated fields of three important return stroke models N91-32736
UJNR Tsunami Workshop Proceedings
[PB91-193656] N91-32747
The role of spin chemistry in the primary events of photosynthesis
[DE91-017301] N91-32752
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms
[DE91-017245] N91-32774
Development of a sensor coordinated kinematic model for neural network controller training
[NASA-CR-188864] N91-32799
Learning-logic: Casting the cortex of the human brain in silicon
[MIT-TR-47] N91-32840
User's manual for PANDA 2: A computer code for calculating equations of state
[DE91-017717] N91-32843
Maximum likelihood estimation applied to target motion analysis using second order derivatives
[FEL-89-A193] N91-32862
Near ground sound propagation in wind
[CSTB-2-89-003-4] N91-32871
Noise levels of USAF aircraft in exercise Luce Belle
[NPL-RSA(EXT)-16] N91-32873
Analogous behavior in the quantum hall effect, anyon superconductivity, and the standard model
[DE91-016609] N91-32970
Atmospheres of comets: Gas dynamic models and inference of kinematic parameters N91-33036
Additions to Mars Global Reference Atmospheric Model (Mars-GRAM)
[NASA-CR-188924] N91-33045
Asymmetries in extragalactic radio sources N91-33050

**MATRICES (MATHEMATICS)**
Lanczos eigensolution method for high-performance computers
[NASA-TM-104108] N91-32526
On polynomial preconditioning for indefinite Hermitian matrices
[NASA-CR-188857] N91-32814
An implementation of the look-ahead Lanczos algorithm for non-Hermitian matrices
[NASA-CR-188889] N91-32820
Krylov subspace methods for complex non-Hermitian linear systems
[NASA-CR-188891] N91-32821
Automatic blocking of nested loops
[NASA-CR-188874] N91-32844
Highly parallel sparse Cholesky factorization
[NASA-CR-188875] N91-32847
An r-matrix approach to nonstandard classes of integrable equations
[MATHS-REPT-A-149] N91-32861
SPARSKIT: A basic tool kit for sparse matrix computations
[NASA-CR-185876] N91-32865

**MATRIX MATERIALS**
Structural characterization of high temperature composites
[NASA-CR-187220] N91-32180
Advanced thermoplastic resins, phase 2
[NASA-CR-187548] N91-32231
Computational simulation of high temperature metal matrix composite behavior
[NASA-TM-104378] N91-32520

**MAXIMUM LIKELIHOOD ESTIMATES**
Automatic land-use classification using LANDSAT-5 thematic mapper data in a region of the Itzehoer Geest. An attempt to improve mapping by combination with panchromatic SPOT data
[DLR-FB-90-47] N91-32542
Maximum likelihood estimation applied to target motion analysis using second order derivatives
[FEL-89-A193] N91-32862

**MAXWELL EQUATION**
Evaluating lightning hazards to building environments using explicit numerical solutions of Maxwell's equations N91-32733

**MCMURDO SOUND**
Measurements in polar stratospheric clouds over Antarctica in September 1989 N91-32534

**MEASURING INSTRUMENTS**
Turbulent energy exchange between atmosphere and surface layer. Methodology, measuring technical realizations, their limits, and possible uses
[ISBN-3-88148-263-6] N91-32596
Thunderstorm detection and warning system atmospheric potential monitor N91-32608
Electrical emissions of airplanes flying in electrified clouds and their effect on airplane measurements of cloud electric fields N91-32609
LT-23: The feedback vibrating capacitor fieldmeter N91-32722

**MECHANICAL DRIVES**
Linear mass actuator
[NASA-CASE-LAR-14352-1] N91-32511
Bidirectional drive and brake mechanism
[NASA-CASE-MSC-21540-1] N91-32514

**MECHANICAL PROPERTIES**
Constitutive modeling of salt behavior: State of the technology
[DE91-017459] N91-32199
Materials qualification technology for ceramic cross-flow filters
[DE91-017715] N91-32232

**MECHANICAL SHOCK**
US TAG for ISO/TC108 mechanical vibration and shock: Minutes of the accredited standards committee on mechanical shock and vibration, S2
[AD-A239536] N91-32521

**MEDICAL EQUIPMENT**
Medical evaluations on the KC-135 1990 flight report summary
[NASA-TM-104740] N91-32776
Health maintenance facility: Dental equipment requirements N91-32777
Dental equipment test during zero-gravity flight N91-32778
Mini-rack testbed evaluation N91-32779
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
ATLS: Catheter and tube placement N91-32782
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals N91-32785
Venipuncture and intravenous infusion access during zero-gravity flight N91-32788
Shuttle Orbiter medical system equipment/supplies evaluation N91-32793

**MEDICAL SERVICES**
ATLS: Catheter and tube placement N91-32782

**MEDICINE**
Evaluation of aerosolized medications during parabolic flight maneuvers N91-32783

**MELTING**
Dynamics of surface melting
[DE91-016344] N91-32206
Simulation and measurement of melting effects on metal sheets caused by direct lightning strikes N91-32644

**MELTS (CRYSTAL GROWTH)**
Critical currents in melt-textured YBa2Cu3O(x)
[DE91-016523] N91-32966

**MEMBRANES**
High energy efficiency and high power density proton exchange membrane fuel cells: Electrode kinetics and mass transport N91-32558
Some recent studies with the solid-ionomer electrochemical capacitor N91-32562
Development of a stretched-membrane dish
[DE91-016499] N91-32574

**MEMORY (COMPUTERS)**
Non volatile solid state magnetic memory technologies N91-32294

New developments in non-volatile semiconductor memory technologies and devices N91-32295
A solid state mass memory for space applications: Technological and system aspects N91-32329
Radiation tolerant 1 micron CMOS technology N91-32335
Single event effects by protons on low Earth orbits: A problem for European manned space missions N91-32349
Measurements of proton upset induced in CMOS devices: Synthesis of CEA studies N91-32356
Recognition of simple visual images using a sparse distributed memory: Some implementations and experiments
[NASA-CR-186616] N91-32797
The Cortex Transform as an image preprocessor for sparse distributed memory: An initial study
[NASA-CR-187436] N91-32798
Efficient packing of patterns in sparse distributed memory by selective weighting of input bits
[NASA-CR-188890] N91-32802
Saving all the bits
[NASA-CR-188879] N91-32817
Toward the efficient implementation of expert systems in Ada
[NASA-CR-188942] N91-32839
Automatic blocking of nested loops
[NASA-CR-188874] N91-32844
Distributed memory approaches for robotic neural controllers
[NASA-CR-188865] N91-32859
Optoelectronic associative memory
[NASA-CASE-NPO-18278-1-CU] N91-32925

**MENTAL PERFORMANCE**
Is thinking computable?
[NASA-CR-188859] N91-32815

**MERCURY COMPOUNDS**
Optical diagnostics of mercuric iodide crystal growth
[DE91-017396] N91-32983

**MESH**
Tests of salinic clouds in test tube of the 7075 carbon fiber with metal mesh (Airbus 330/340)
[INFORME-I-520/90] N91-32175

**MESOMETEOROLOGY**
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688

**MESONS**
A unified formalism for gamma gamma to meson and psi to gammaX with possible tests for hybrid and gluonic hadrons
[RAL-91-039] N91-32877

**MESOSCALE PHENOMENA**
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida
[DE91-017445] N91-32743

**MESSAGE PROCESSING**
SITA satellite air communications implementation N91-32113
Near-term satellite-based oceanic air traffic control: Ground system description N91-32116
US oceanic air traffic control: Past, present, and future N91-32118
Ground automation processing of near-term oceanic ATC data link messages N91-32127
Programming in a proposed 9X distributed Ada
[NASA-CR-188831] N91-32825

**MESSAGES**
Ground automation processing of near-term oceanic ATC data link messages N91-32127

**METAL BONDING**
Advanced thermoplastic resins, phase 2
[NASA-CR-187548] N91-32231
Adhesive bonding handbook for advanced structural materials
[ESA-PSS-03-210-ISSUE-1] N91-32234

**METAL FILMS**
Tribological behavior of silver films prepared on ceramic surfaces by ion-beam-assisted deposition
[DE91-017306] N91-32505
Soft x ray magnetic scattering study of thin films and multilayers
[DE91-017472] N91-32920

**METAL IONS**
Multiheteromacrocycles that complex metal ions
[DE91-016292] N91-32205
Spectroscopic properties of Nd3+ dopant ions in phosphate laser glass
[DE91-017665] N91-32985

**METAL MATRIX COMPOSITES**
Matrix-dominated thermoviscoplasticity in fibrous metal-matrix composite materials N91-32173
Computational simulation of high temperature metal matrix composite behavior
[NASA-TM-104378] N91-32520
Simplified micromechanical equations for thermal residual stress analysis of coated fiber composites
[NASA-CR-187599] N91-32527

**METAL OXIDE SEMICONDUCTORS**
Design, development, and qualification of special super N-channel MOSFET die for space applications N91-32297
Temperature compensation of PMOS dosimeters N91-32336
Total dose effects in MOS systems: Influence of the initial hydrogen distribution N91-32338
Space radiation effects on power MOSFET: Threshold-voltage shift with dose rate N91-32363

**METAL PARTICLES**
Instability of shaped charged jets with general constitutive equations
[FFI-91/4004] N91-32203

**METAL SHEETS**
Simulation and measurement of melting effects on metal sheets caused by direct lightning strikes N91-32644

**METAL SURFACES**
Picosecond time-resolved electron diffraction studies of laser heated metals
[DE91-016345] N91-32207
Silver lined ceramic vessel and method of preparation
[AD-D014953] N91-32224

**METAL VAPOR LASERS**
High average power magnetic modulator for copper lasers
[DE91-016560] N91-32482

**METALLIZING**
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application
[NASA-TM-103551] N91-32217

**METALS**
Tests of salinic clouds in test tube of the 7075 carbon fiber with metal mesh (Airbus 330/340)
[INFORME-I-520/90] N91-32175
Dynamics of surface melting
[DE91-016344] N91-32206
The new metals and alloys compilation, a powerful materials analysis tool
[DE91-016199] N91-32208
Finite element implementation of state variable-based viscoplasticity models
[NASA-CR-187212] N91-32523

**METEOROLOGICAL BALLOONS**
Aerosol sensing from balloons using photopolarimetry N91-32538

**METEOROLOGICAL CHARTS**
Severe thunderstorm cases of July 1989 thru June 1990
[PB91-201392] N91-32738

**METEOROLOGICAL INSTRUMENTS**
The physics and instrumentation of passive atmospheric sounding: A review of the methods of remote sensing of temperature and moisture in the Earth's lower atmosphere
[ESA-STR-231] N91-32597
Experience gained in operation of the VLF ATD lightning location system N91-32707
Extension of and improvements to the ERDC low frequency magnetic direction finding system N91-32708

**METEOROLOGICAL PARAMETERS**
Information of meteorological extremes for the design and operation of energy systems
[WCAP-13] N91-32659
NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review
[NASA-CP-3126] N91-32660
MAMS: High resolution atmospheric moisture/surface properties N91-32664
Global lightning studies N91-32667
WetNet operations N91-32668
Electrification in winter storms and the analysis of thunderstorm overflight N91-32678

**METEOROLOGICAL RADAR**
Methods for the automatic de-aliasing of the Doppler velocity of a weather radar
[DLR-FB-91-08] N91-32249
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686

**METEOROLOGICAL SERVICES**
CLINEWS: NOAA Western Region computer programs and problems
[PB91-200709] N91-32831

**METEOROLOGY**
Information of meteorological extremes for the design and operation of energy systems
[WCAP-13] N91-32659
NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review
[NASA-CP-3126] N91-32660
Tropical Pacific moisture variability N91-32690
South Pacific convergence zone and global scale circulations (Jul. 1987 - Jul. 1991). Observational and modeling studies of heat, moisture, precipitation, and global-scale circulation patterns (Jul. 1990 - Jul. 1993) N91-32691
Study on observational systems: A review of meteorological and oceanographic education in observational techniques and the relationship to national facilities and needs
[PB91-198168] N91-32739
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida
[DE91-017445] N91-32743

**METHANE**
Catalytic combustion of methane
[PB91-206391] N91-32190
New directions for the catalytic conversion of methane
[PB91-206417] N91-32191
Helium isotopic constraints on terrestrial degassing and the transcrustal transport of mantle methane
[PB91-206458] N91-32594
Vertical mixing and methane photochemistry in the atmosphere of Uranus: Analysis of Voyager UVS occultation experiments
[NASA-CR-188789] N91-33042

**METHYL ALCOHOL**
The effect of chemical additives on the synthesis of ethanol
[DE91-016586] N91-32192

**METHYL COMPOUNDS**
Analysis of samples for the second (1990) round robin interlaboratory exercise
[FFI-91/6004] N91-32188

**MICROBALLOONS**
Method and apparatus for producing microshells
[NASA-CASE-NPO-16635-1-CU] N91-32240

**MICROBURSTS (METEOROLOGY)**
Synthetic aperture radar imagery of airports and surrounding areas: Study of clutter at grazing angles and their polarimetric properties
[NASA-CR-4398] N91-32088
VHF discharges in storm cells producing microbursts N91-32620

**MICROCHANNEL PLATES**
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs)
[DE91-016196] N91-32407

**MICROCLIMATOLOGY**
A guidebook for the control of summer heat islands
[DE91-016246] N91-32586

**MICROCRACKS**
Analytical and numerical studies of fracture and fatigue in ceramic materials N91-32516

**MICROELECTRONICS**
ESA Electronic Components Conference
[ESA-SP-313] N91-32291
A new approach to the reliability of electronic material systems N91-32310
High performance packages for space applications N91-32311
The NASA Microelectronics Space Radiation Effects Program (MSREP) at the Jet Propulsion Laboratory N91-32331
CECIL: Collaboration between companies and research agencies in heavy ion test of spacecraft microelectronics N91-32348
Total dose study on LS-, ALS, and F-technology integrated circuits N91-32354
Evaluation of advanced microelectronics for inclusion in MIL-STD-975 N91-32390
Method for anisotropic etching in the manufacture of semiconductor devices
[NASA-CASE-MSC-21631-1] N91-32947

**MICROMECHANICS**
Integrated mechanics for the passive damping of polymer-matrix composites and composite structures
[NASA-TM-104346] N91-32181
Computational simulation of high temperature metal matrix composite behavior
[NASA-TM-104378] N91-32520
Simplified micromechanical equations for thermal residual stress analysis of coated fiber composites
[NASA-CR-187599] N91-32527

**MICROPROCESSORS**
Single event test method and test results on the Intel 80386 N91-32343
Aircrew part-task training research and development in the 1980s: Lessons learned
[AD-A239456] N91-32773
An assessment of the connection machine
[NASA-CR-188876] N91-32801

**MICROSCOPES**
Theoretical modelling of AFM for bimetallic tip-substrate interactions
[NASA-TM-105280] N91-32215
High-energy synchrotron radiation x ray microscopy: Present status and future prospects
[DE91-016894] N91-32893
EXAM: A search for extragalactic antimatter N91-33035

**MICROSCOPY**
High-energy synchrotron radiation x ray microscopy: Present status and future prospects
[DE91-016894] N91-32893

**MICROSTRIP TRANSMISSION LINES**
Planar gallium arsenide NPNP microwave switch
[AD-D014948] N91-32398

**MICROSTRUCTURE**
Effect of thermal exposure, forming, and welding on high-temperature, dispersion-strengthened aluminum alloy: Al-8Fe-1V-2Si
[NASA-CR-187575] N91-32200
Advances in the design of toughened ceramics
[DE91-016767] N91-32228
Materials qualification technology for ceramic cross-flow filters
[DE91-017715] N91-32232
A study of fracture mechanisms in ATD roller bearing
[NASA-CR-184200] N91-32497
Analytical and numerical studies of fracture and fatigue in ceramic materials N91-32516
Formation and annealing behavior of an amorphous layer induced by tin implantation into sapphire
[DE91-015929] N91-32960
Microstructural change and its influence on stress-strain behavior of two superplastic materials
[DE91-017431] N91-32980

**MICROWAVE ANTENNAS**
Report on the photogrammetric determination of the shape of a 10m diameter microwave antenna
[NPL-MOM-103] N91-32248

**MICROWAVE CIRCUITS**
Qualification strategy for multi-chip packaging for space applications N91-32312
Design and evaluation of a GaAs MMIC X-band active RC quadrature power divider
[FEL-91-A076] N91-32396
Capability approval programme for Microwave Hybrid Integrated Circuits (MHICS)
[ESA-PSS-01-612-ISSUE-1] N91-32420

**MICROWAVE EQUIPMENT**
A power beaming based infrastructure for space power
[DE91-017533] N91-32169
An evaluation programme for the capability approval of GaAs MMICs N91-32303
Reliability of microwave bipolar silicon transistors N91-32305
Bipolar microwave transistor technology N91-32324
Specification, procurement and testing of passivated microwave semiconductor chips for space applications N91-32393
Wideband microwave generation with GaAs photoconductive switches
[DE91-017544] N91-32415

**MICROWAVE FILTERS**
Performance of a high T(sub c) superconducting ultra-low loss microwave stripline filter N91-32255

**MICROWAVE FREQUENCIES**
DSS 13 phase 2 pedestal room microwave layout N91-32272

**MICROWAVE IMAGERY**
Deriving Earth science products from SSM/I N91-32684

**MICROWAVE LANDING SYSTEMS**
Results of MLS/ILS comparison flight test at the Yuma MCAS, Arizona
[DOT/FAA/CT-TN91/10] N91-32092

**MICROWAVE POWER BEAMING**
The United Kingdom waveguide power standards above 40 GHz
[NPL-DES-105] N91-32395

**MICROWAVE RADIOMETERS**
AMPR/SSMI data comparisons N91-32665

**MICROWAVE SOUNDING**
Global water cycle N91-32661
Global temperature variations N91-32683
Monitoring, analyzing, and modeling global climate N91-32689

**MICROWAVE TRANSMISSION**
Microwave blind mate coaxial connectors N91-32317

**MICROWAVES**
DSS 13 phase 2 pedestal room microwave layout N91-32272
Initial testing of a two-dimensional computer code for microwave-induced surface breakdown in air
[DE91-015763] N91-32286
The United Kingdom waveguide power standards above 40 GHz
[NPL-DES-105] N91-32395
Planar gallium arsenide NPNP microwave switch
[AD-D014948] N91-32398
Wideband microwave generation with GaAs photoconductive switches
[DE91-017544] N91-32415
Self-generated stochastic heating in an RF discharge
[DE91-017404] N91-32948

**MIDDLE ATMOSPHERE**
On the nonlinear response of minor atmospheric species to linear gravity waves N91-32593

**MIE SCATTERING**
The internal caustic structure of illuminated liquid droplets
[NASA-CR-187194] N91-32474

**MILLIMETER WAVES**
Millimeter wavelength communications applications for the SEI
[NASA-TM-105275] N91-32287

**MIMD (COMPUTERS)**
An assessment of the connection machine
[NASA-CR-188876] N91-32801

**MINERALS**
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada
[NASA-CR-183493] N91-32591

**MINIATURE ELECTRONIC EQUIPMENT**
Progress in submicron technologies N91-32394

**MIRRORS**
Zonal deformable mirror for laser wavefront control
[DE91-017085] N91-32483
Quantum well, beam deflecting surface emitting lasers
[NASA-CASE-NPO-18243-1-CU] N91-32489
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy
[DE91-016571] N91-32917
Method and apparatus for phasing segmented mirror arrays
[NASA-CASE-NPO-18095-1-CU] N91-32923

**MIS (SEMICONDUCTORS)**
Resistive gate magnetic field sensor
[AD-D014952] N91-32471

**MISSILES**
A survey of laser lightning rod techniques N91-32645
WASP, the Weapon Analysis and Simulation Program
[FEL-90-A322] N91-32813

**MISSION PLANNING**
Scouting the neighborhood: In our lifetime
[DE91-017083] N91-32151
Rosetta/CNSR: A comet-nucleus sample-return mission and system definition document
[ESA-SP-1125] N91-32152
Optimal cooperative time-fixed impulsive rendezvous N91-32153
Multimegawatt electric propulsion system design considerations
[NASA-TM-105152] N91-32164
Modeling preparation costs for space missions by using major cost drivers N91-32279
Working Papers: Astronomy and Astrophysics Panel Reports
[NASA-CR-188785] N91-33017
High energy from space N91-33023

**MIST**
Evaluation of aerosolized medications during parabolic flight maneuvers N91-32783

**MIXED OXIDES**
Critical currents in melt-textured YBa2Cu3O(x)
[DE91-016523] N91-32966
Scaling behavior of the fluctuations in magnetization and conductivity of untwinned YBa2Cu3O(7-delta)
[DE91-016524] N91-32967
Flux pinning by planar defects in single crystal YBa2Cu3O(7-delta)
[DE91-016525] N91-32968

**MIXING LAYERS (FLUIDS)**
Supersonic mixing enhancement by vorticity for high-speed propulsion
[NASA-CR-188920] N91-32079

**MIXTURES**
Advantages of enthalpy-temperature diagrams for nonazeotropic refrigerant mixtures
[DE91-016774] N91-32991

**MOBILE COMMUNICATION SYSTEMS**
Aeronautical mobile satellite services ESA-PRODAT/SITA AIRCOM service trials programme N91-32106
Aeronautical Mobile Satellite Service (AMSS) message and voice access request transit delay N91-32107
Satellite data link research and development program in Japan N91-32108

**MODAL RESPONSE**
Nonlinear dynamic analysis of flexible multibody systems
[NASA-CR-187597] N91-32519

**MODULATION TRANSFER FUNCTION**
Measurement of modulation transfer function for four types of imaging elements used in fast cameras
[DE91-017399] N91-32475

**MODULATORS**
Reliable, high repetition rate thyratron grid driver used with a magnetic modulator
[DE91-016558] N91-32413
High average power magnetic modulator for copper lasers
[DE91-016560] N91-32482

**MOIRE EFFECTS**
Three dimensional moire pattern alignment
[NASA-CASE-MSC-21416-1] N91-32922

**MOISTURE**
Tropical Pacific moisture variability N91-32690
South Pacific convergence zone and global scale circulations (Jul. 1987 - Jul. 1991). Observational and modeling studies of heat, moisture, precipitation, and global-scale circulation patterns (Jul. 1990 - Jul. 1993) N91-32691

**MOISTURE CONTENT**
Modeling water content effects in polymer electrolyte fuel cells
[DE91-016027] N91-32573

**MOLDING MATERIALS**
Manufacture of containers from an oriented biopolymer N91-32999

**MOLECULAR ABSORPTION**
Infrared radiative energy transfer in gaseous systems
[NASA-CR-188925] N91-32462

**MOLECULAR BEAMS**
Crossed beams studies of nonadiabatic collision dynamics
[DE91-016250] N91-32879

**MOLECULAR CHAINS**
Oxygen ordered superstructures and domain formation in YBa2Cu3O(7-x)
[DE90-015633] N91-32958

**MOLECULAR COLLISIONS**
Conservation of angular momentum in direct simulation Monte Carlo method N91-32038
Crossed beams studies of nonadiabatic collision dynamics
[DE91-016250] N91-32879
Atomic and molecular collision processes
[DE91-017649] N91-32897

**MOLECULAR EXCITATION**
Dynamics of charge-transfer excited states relevant to photochemical energy conversion
[DE91-017710] N91-32578
Atomic and molecular collision processes
[DE91-017649] N91-32897

**MOLECULAR FLOW**
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root
[DE91-016255] N91-32749

**MOLECULAR GASES**
Infrared radiative energy transfer in gaseous systems
[NASA-CR-188925] N91-32462

**MOLECULAR STRUCTURE**
Atomic and molecular collision processes
[DE91-017649] N91-32897
Oxygen ordered superstructures and domain formation in YBa2Cu3O(7-x)
[DE90-015633] N91-32958
Mechanisms of defect production and atomic mixing in high energy displacement cascades: A molecular dynamics study
[DE91-017082] N91-32979

**MOLECULAR WEIGHT**
Addition polyimides with enhanced processability
[NASA-CASE-LEW-15043-1] N91-32230

**MOLYBDENUM**
Fabrication of advanced x ray optics with magnetron mini-source arrays
[DE91-017093] N91-32919

**MOLYBDENUM DISULFIDES**
Lubrication with sputtered MoS2 films: Principles, operation, limitations
[NASA-TM-105292] N91-32216

**MOMENTUM TRANSFER**
Color transparency: Enchantment and effort
[DE91-016951] N91-32890

**MONITORS**
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780

**MONOCHROMATORS**
A simple sagittal focusing crystal which utilizes a bimetallic strip
[DE91-017324] N91-32975
**MONOMERS**
Addition polyimides with enhanced processability
[NASA-CASE-LEW-15043-1] N91-32230
**MONTE CARLO METHOD**
On the parallel processing of Direct Simulation Monte Carlo method N91-32037
Conservation of angular momentum in direct simulation Monte Carlo method N91-32038
Rarefied gas numerical wind tunnel 6: Delta wing N91-32039
Reciprocity theory of binary inelastic encounters
[IC-AERO-89-03] N91-32425
Empirical results of a hybrid Monte Carlo method for the solution of Poisson's equation
[DE91-016240] N91-32863
**MOSSBAUER EFFECT**
High pressure Moessbauer spectroscopy in diamond anvil cells
[DE91-016018] N91-32961
**MOTION SICKNESS**
Motion Sickness: Significance in Aerospace Operations and Prophylaxis
[AGARD-LS-175] N91-32759
Signs and symptoms of motion sickness and its basic nature N91-32760
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory N91-32761
Physical characteristics of stimuli provoking motion sickness N91-32762
Factors influencing susceptibility: Individual differences and human factors N91-32763
Space sickness N91-32764
Simulator sickness N91-32765
Sea sickness N91-32766
Prevention and treatment of motion sickness: Non-pharmacological therapy N91-32767
Assessment of drug effectiveness N91-32768
Management of acute and chronic motion sickness N91-32769
**MOTION SICKNESS DRUGS**
Space sickness N91-32764
**MOTOR VEHICLES**
Vehicle Animation Software (VAS) to animate results obtained from vehicle handling and rollover simulations and tests
[PB91-194142] N91-32832
**MOUNTAINS**
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada
[NASA-CR-183493] N91-32591
**MOUNTING**
Mini-rack testbed evaluation N91-32779
ATLS: Catheter and tube placement N91-32782
**MTBF**
Development and operation of a solid-state switch for thyratron replacement
[DE91-016553] N91-32401
**MULLITES**
Materials qualification technology for ceramic cross-flow filters
[DE91-017715] N91-32232
**MULTIPHOTON ABSORPTION**
High-intensity photoionization of H2
[DE91-017087] N91-32885
**MULTIPLEXING**
Present and future supercomputer network architectures
[DE91-018035] N91-32855
**MULTIPROCESSING (COMPUTERS)**
Parallel scalability of the spectral transform method
[DE91-017991] N91-32744
An assessment of the connection machine
[NASA-CR-188876] N91-32801
Performance of a benchmark implementation of the Van Slyke and Wets algorithm for stochastic programs on the Alliant FX/8
[DE91-016515] N91-32833
Gigaflop performance on a CRAY-2: Multitasking a computational fluid dynamics application
[NASA-TM-4305] N91-32841
Parallel computing and domain decomposition
[DE91-017967] N91-32854
**MULTISPECTRAL BAND SCANNERS**
MAMS: High resolution atmospheric moisture/surface properties N91-32664
**MULTIVARIATE STATISTICAL ANALYSIS**
G/SPLINES: A hybrid of Friedman's Multivariate Adaptive Regression Splines (MARS) algorithm with Holland's genetic algorithm
[NASA-CR-188935] N91-32836

## N

**N-P-N JUNCTIONS**
An approximate HSPICE model for orbit low noise analog bipolar NPN transistors
[DE91-017220] N91-32414
**NARROWBAND**
Integrated filter and detector array for spectral imaging
[NASA-CASE-NPO-18317-1-CU] N91-32926
**NASA SPACE PROGRAMS**
An overview of the NASA electronic components information management system N91-32369
NASA's challenge for tomorrow N91-32374
Collaboration technology and space science
[NASA-CR-188861] N91-32846
Coping with data from Space Station Freedom
[NASA-CR-188885] N91-33005
Policy opportunities N91-33029
**NATIONAL AIRSPACE SYSTEM**
Rotorcraft master plan
[AD-A239444] N91-32081
Satellite Communications (SATCOM) N91-32095
Data Multiplexing Network (DMN), phase 3: Equipment Operational Test and Evaluation (OT&E)/Integration test plan
[DOT/FAA/CT-TN91/24] N91-32283
**NATURAL GAS**
Natural gas conversion process
[DE91-015759] N91-32235
Impact of fundamental technical improvements to natural gas fuel cells
[PB91-206615] N91-32570
**NAUSEA**
Physical characteristics of stimuli provoking motion sickness N91-32762
**NAVIER-STOKES EQUATION**
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034
Numerical calculation of flow for scramjet engine N91-32035
Aerodynamic design of non-planar wing by inverse method with Navier-Stokes equation N91-32045
Navier-Stokes simulation for complete aircraft configuration N91-32046
The role of computational fluid dynamics in aeronautical engineering (8): A mixed compression inlet for a supersonic airplane N91-32048
The three dimensional Navier-Stokes simulations of flow over a wing without any turbulent modelling N91-32051
Developing laminar flow and heat transfer in orthogonally rotating square ducts N91-32054
Flow and heat transfer in a curved annular pipe N91-32055
Wall function method with conservation property N91-32058
Navier-Stokes analysis for flowfield around hovering rotor N91-32066
Navier-Stokes computations of three-dimensional turbine cascade flows N91-32068
Application of 3-D Navier-Stokes computation to turbine vane design N91-32069
Thin layer Navier-Stokes solutions for transonic multibody interference
[AD-A234252] N91-32072
Computational Fluid Dynamics
[VKI-LS-1991-01] N91-32426
The Euler and Navier-Stokes equations. Wellposedness, stability and composite grids N91-32427
Spectral element methods for the unsteady Navier-Stokes equations N91-32432
Parabolized Navier-Stokes methods for hypersonic flows N91-32433
Parabolized Navier-Stokes methods for ducted flow systems N91-32434
Solution of perfect gas viscous flows via compressible Navier-Stokes equations with wallslip conditions
[ONERA-RSF-13/3637-AY] N91-32435
Navier-Stokes flow calculations by an implicit non-centered method N91-32436
Appraisal of the suitability of turbulence models in flow calculations: A UK view on turbulence models for turbulent shear flow calculations N91-32450
Determining finite volume elements for the 2D Navier-Stokes equations
[DE91-016028] N91-32452
Numerical study of Stokes flows with suspended particles
[DE91-017011] N91-32455
An approximate Riemann solver for hypervelocity flows
[NASA-CR-187629] N91-32463
**NAVIGATION**
The FAA/ARINC initial implementation of AMSS N91-32112
**NAVIGATION AIDS**
The First Annual International Satellite Surveillance and Communication Symposium
[DOT/FAA/RD-91/21] N91-32093
Automatic Dependent Surveillance (ADS) Program summary N91-32094
Satellite Communications (SATCOM) N91-32095
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
International Civil Aviation Organization (ICAO) Automatic Dependent Surveillance Panel (ADSP) activities N91-32097
International program summary N91-32098
Automatic dependent surveillance Pacific engineering trials N91-32099
ADS (Automatic Dependent Surveillance) PET (Pacific Engineering Trial) program in Japan N91-32100
Australian experiments in Automatic Dependent Surveillance (ADS) including the Pacific Engineering Trials (PET) N91-32101
**NEODYMIUM COMPOUNDS**
Spectroscopic properties of Nd3+ dopant ions in phosphate laser glass
[DE91-017665] N91-32985
**NETS**
Integrated compensation of geodetic nets in point masses model
[SER-C-362] N91-32547
**NETWORK CONTROL**
Lightning location system supervising Swedish power transmission network N91-32617
**NETWORK SYNTHESIS**
Design and evaluation of a GaAs MMIC X-band active RC quadrature power divider
[FEL-91-A076] N91-32396
**NETWORKS**
The 1980 equalization diagnosis of the German main triangulation network. 5: Neighborhood, conclusions --- thematic maps
[SER-B-272-PT-2] N91-32548
Weak positive cloud-to-ground flashes in Northeastern Colorado N91-32712
**NEURAL NETS**
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
A reference model dynamics-CMAC algorithm for simulation and control of robotic manipulators N91-32507
Predicting cloud-to-ground lightning with neural networks N91-32646
Development of a sensor coordinated kinematic model for neural network controller training
[NASA-CR-188864] N91-32799
G/SPLINES: A hybrid of Friedman's Multivariate Adaptive Regression Splines (MARS) algorithm with Holland's genetic algorithm
[NASA-CR-188935] N91-32836
Analog hardware for learning neural networks
[NASA-CASE-NPO-17664-1-CU] N91-32852
Equations of learning and capacity of layered neural networks
[AD-A229633] N91-32857
Distributed memory approaches for robotic neural controllers
[NASA-CR-188865] N91-32859
**NEUROLOGY**
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory N91-32761
**NEURONS**
Contour-map encoding of shape for early vision
[NASA-CR-188937] N91-32545
Learning-logic: Casting the cortex of the human brain in silicon
[MIT-TR-47] N91-32840
**NEUTRAL BEAMS**
Heavy Neutral Beam Probe for edge plasma analysis in tokamaks
[DE91-016290] N91-32935
**NEUTRAL PARTICLES**
Beam-driven currents in the 1/nu regime in a helical system
[NIFS-27] N91-32955
**NEUTRINOS**
The effect of a neutrino magnetic moment on nuclear excitation processes
[RAL-91-010] N91-32876
Testing the big bang: Light elements, neutrinos, dark matter, and large-scale structure
[DE91-017379] N91-33040
**NEUTRON DIFFRACTION**
Neutron diffraction by the flux lattice in high-Tc superconductors
[DE91-017866] N91-32418

Neutron scattering from the flux lattice in high temperature superconductors
[DE91-017947] N91-32419

**NEUTRON FLUX DENSITY**
Benchmark field study of deep neutron penetration
[DE91-015677] N91-32886
Radiation hardening of diagnostics
[DE91-018039] N91-32953

**NEUTRON IRRADIATION**
Initial operational experience after installation of the D3-D radiation shield
[DE91-017765] N91-32949

**NEUTRON SCATTERING**
Neutron scattering from the flux lattice in high temperature superconductors
[DE91-017947] N91-32419
High energy spin waves in iron measured by neutron scattering
[DE91-017868] N91-32902

**NEUTRON SOURCES**
International workshop on cold neutron sources
[DE91-017559] N91-32891
Radiation hardening of diagnostics
[DE91-018039] N91-32953

**NEUTRONS**
Neutron, gamma ray and post-irradiation thermal annealing effects on power semiconductor switches
[NASA-TM-105248] N91-32410
Benchmark field study of deep neutron penetration
[DE91-015677] N91-32886
Study of neutron-proton interaction in the 300 to 700 MeV energy region
[DE91-016487] N91-32887
Fast neutron dosimetry
[DE91-016907] N91-32894
Nuclear and astronomical constraints on the site for r-process nucleosynthesis
[DE91-016561] N91-33038

**NEWTON METHODS**
A family of optimally conditioned quasi-Newton updates for unconstrained optimization
[MATHS-REPT-A-143] N91-32807
Coalescing binary systems of compact objects to (post) sup 5/2 Newtonian order: Late-time evolution and gravitational radiation emission N91-33037

**NICKEL**
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application
[NASA-TM-103551] N91-32217
The effects of platinum on nickel electrodes in the nickel hydrogen cell N91-32554
Raman spectral observation of a new phase observed in nickel electrodes cycled to failure N91-32556
Impedances of nickel electrodes cycled in various KOH concentrations N91-32557

**NICKEL ALLOYS**
Comparison of high temperature, high frequency core loss and dynamic B-H loops of two 50 Ni-Fe crystalline alloys and an iron-based amorphous alloy
[NASA-TM-105205] N91-32412

**NICKEL COMPOUNDS**
Sodium-metal chloride battery research at JPL N91-32566

**NICKEL HYDROGEN BATTERIES**
The effects of platinum on nickel electrodes in the nickel hydrogen cell N91-32554
Physical and chemical analysis of a Ni/H2 cell N91-32555
Raman spectral observation of a new phase observed in nickel electrodes cycled to failure N91-32556
Performance of a dual anode nickel-hydrogen cell N91-32563
Multiple cell common pressure vessel nickel hydrogen battery N91-32564
Small capacity, low cost (Ni-H2) design concept for commercial, military, and higher-volume aerospace applications N91-32565

**NITRIC ACID**
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588

**NITROGEN OXIDES**
Investigation of radiative interactions in supersonic internal flows
[NASA-CR-188820] N91-32078
Ionization of NO at high temperature
[NASA-CR-188798] N91-32187
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588

**NOBLE METALS**
Silver lined ceramic vessel and method of preparation
[AD-D014953] N91-32224

**NOISE REDUCTION**
Designs for surge immunity in critical electronic facilities N91-32635

**NOISE TEMPERATURE**
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 1: Design and ground tests N91-32269
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 2: Tests on the antenna N91-32270

**NONADIABATIC CONDITIONS**
Crossed beams studies of nonadiabatic collision dynamics
[DE91-016250] N91-32879

**NONDESTRUCTIVE TESTS**
Spectroscopic wear detector
[NASA-CASE-LEW-15200-1] N91-32167
Gas tungsten arc adaptive welding
[DE91-017848] N91-32513

**NONEQUILIBRIUM IONIZATION**
Ionization of NO at high temperature
[NASA-CR-188798] N91-32187

**NONLINEAR EQUATIONS**
Time domain finite elements in optimal control with application to launch vehicle guidance N91-32156

**NONLINEAR PROGRAMMING**
Control design variable linking for optimization of structural/control systems N91-32144

**NONLINEAR SYSTEMS**
Nonlinear dynamic analysis of flexible multibody systems
[NASA-CR-187597] N91-32519
Bifurcations and patterns in non-linear dissipative systems
[DE91-017402] N91-32984

**NONLINEARITY**
Resonant triad in boundary-layer stability. Part 1: Fully nonlinear interaction
[NASA-TM-105208] N91-32458
Resonant triad in boundary-layer stability. Part 2: Composite solution and comparison with observations
[NASA-TM-105209] N91-32459
Nonlinear feedbacks between stratocumulus and synoptic-scale systems N91-32674
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687
Computer simulation studies of high energy collision cascades
[DE91-016225] N91-32903
Excitation of nonlinear wake field in a plasma for particle acceleration
[DE91-017386] N91-32945

**NORMAL SHOCK WAVES**
Numerical simulation of shock wave emanating from a square shock tube N91-32061
A laser velocimeter investigation of the normal shock-wave boundary layer interaction
[NASA-TM-105201] N91-32440

**NORTHERN HEMISPHERE**
Potential vorticity index N91-32672

**NOWCASTING**
Predicting cloud-to-ground lightning with neural networks N91-32646

**NOZZLE DESIGN**
Nozzle fabrication technique
[NASA-CASE-MSC-21299-2] N91-32508

**NOZZLE FLOW**
Numerical analysis of bubbly liquid in convergent-divergent nozzle N91-32052
An experimental study of natural and forced modes in an axisymmetric jet
[NASA-TM-105225] N91-32074

**NUCLEAR ASTROPHYSICS**
Nuclear and astronomical constraints on the site for r-process nucleosynthesis
[DE91-016561] N91-33038

**NUCLEAR CAPTURE**
Nuclear and astronomical constraints on the site for r-process nucleosynthesis
[DE91-016561] N91-33038
Astrophysical neutron capture processes
[DE91-017071] N91-33039

**NUCLEAR ELECTRIC PROPULSION**
MPD thruster technology
[NASA-TM-105242] N91-32162

**NUCLEAR ENERGY**
Inherently safe nuclear-driven internal combustion er gines
[LE91-016568] N91-32503
Advanced high brightness ion RF accelerator applications in the nuclear energy
[DE91-016075] N91-32905

**NUCLEAR FUELS**
The promise of magnetized fuel: High gain in inertial confinement fusion
[DE91-016321] N91-32937

**NUCLEAR FUSION**
Edge electric field profiles of H-mode plasmas in JFT-2M tokamak
[NIFS-26] N91-32956
Testing the big bang: Light elements, neutrinos, dark matter, and large-scale structure
[DE91-017379] N91-33040

**NUCLEAR MAGNETIC RESONANCE**
La(sup 139) NMR and NQR study of the temperature dependent structure of La2CuO4+(delta)
[DE91-016201] N91-32959

**NUCLEAR MODELS**
Color transparency: Enchantment and effort
[DE91-016951] N91-32890
Single- and double-charge exchange at low pion energies
[DE91-017829] N91-32901

**NUCLEAR PROPULSION**
Performance enhancement using power beaming for electric propulsion Earth orbital transporters
[DE91-017287] N91-32168

**NUCLEAR QUADRUPOLE RESONANCE**
La(sup 139) NMR and NQR study of the temperature dependent structure of La2CuO4+(delta)
[DE91-016201] N91-32959

**NUCLEAR REACTIONS**
Color transparency: Enchantment and effort
[DE91-016951] N91-32890
Giant resonances in single and double charge exchange
[DE91-017822] N91-32900
Single- and double-charge exchange at low pion energies
[DE91-017829] N91-32901
Review of the heavy ion physics sessions
[DE91-017828] N91-32912

**NUCLEAR REACTORS**
Inherently safe nuclear-driven internal combustion engines
[DE91-016568] N91-32503
L to H mode transitions and associated phenomena in divertor tokamaks
[DE91-017074] N91-32940

**NUCLEAR ROCKET ENGINES**
A nuclear thermal rocket engine design based on the particle bed reactor suitable for a Mars mission
[DE91-016898] N91-32160

**NUCLEAR WEAPONS**
Benchmark field study of deep neutron penetration
[DE91-015677] N91-32886

**NUCLEATION**
Laboratory and field studies of stratospheric aerosols: Phase changes under high supersaturation N91-32533

**NUCLEI (NUCLEAR PHYSICS)**
Giant resonances in single and double charge exchange
[DE91-017822] N91-32900

**NUCLEON-NUCLEON INTERACTIONS**
Study of neutron-proton interaction in the 300 to 700 MeV energy region
[DE91-016487] N91-32887

**NUCLEONS**
Color transparency: Enchantment and effort
[DE91-016951] N91-32890
Review of the heavy ion physics sessions
[DE91-017828] N91-32912

**NUMERICAL ANALYSIS**
Numerical analysis of bubbly liquid in convergent-divergent nozzle N91-32052
Fully developed mixed convection in a horizontal pipe N91-32057
Compressible flows with vortical disturbances around a cascade of airfoils N91-32083
Fluctuation splitting schemes for the 2D Euler equations N91-32430
Numerical study of partitioned turbulence
[ONERA-RSF-20/3419-AY-124A] N91-32437
Numerical study of Stokes flows with suspended particles
[DE91-017011] N91-32455
Parallelizing the spectral transform method, part 2
[DE91-017131] N91-32456

**NUMERICAL CONTROL**
Versatile, low-cost, computer-controlled, sample positioning system for vacuum applications
[NASA-CR-187144] N91-32237
Lightning protection of full authority digital electronic systems N91-32643
Design of lightning protection for a full-authority digital engine control N91-32717

**NUMERICAL INTEGRATION**
Finite element implementation of state variable-based viscoplasticity models
[NASA-CR-187212] N91-32523

GOOSE: A Generalized Object-Oriented Simulation Environment
[DE91-016771] N91-32842
Ultrarelativistic atomic collisions
[DE91-016768] N91-32884
**NUMERICAL STABILITY**
Some stable reconstruction algorithms for electrical impedance tomography
[DE91-016569] N91-32473
A biconjugate gradient type algorithm on massively parallel architectures
[NASA-CR-188888] N91-32848

## O

**OBLATE SPHEROIDS**
The effect of the Earth's oblate spheroid shape on the accuracy of a time-of-arrival lightning ground strike locating system N91-32706
**OBSERVATION**
Examinations of the rational utilization of the Global Positioning System (GPS) in local networks
[SER-C-361] N91-32129
Study on observational systems: A review of meteorological and oceanographic education in observational techniques and the relationship to national facilities and needs
[PB91-198168] N91-32739
**OCCULTATION**
Vertical mixing and methane photochemistry in the atmosphere of Uranus: Analysis of Voyager UVS occultation experiments
[NASA-CR-188789] N91-33042
**OCEAN CURRENTS**
Gulf of Mexico circulation modeling study: Annual progress report: Years 3 and 4
[PB91-210666] N91-32746
**OCEAN DATA ACQUISITIONS SYSTEMS**
Component local velocities of a ship along a defined axis
[ARE-TM(UHR)-91305] N91-32424
**OCEAN DYNAMICS**
Gulf of Mexico circulation modeling study: Annual progress report: Years 3 and 4
[PB91-210666] N91-32746
**OCEAN MODELS**
Gulf of Mexico circulation modeling study: Annual progress report: Years 3 and 4
[PB91-210666] N91-32746
**OCEAN SURFACE**
Gulf of Mexico circulation modeling study: Annual progress report: Years 3 and 4
[PB91-210666] N91-32746
**OCEANOGRAPHIC PARAMETERS**
Gulf of Mexico circulation modeling study: Annual progress report: Years 3 and 4
[PB91-210666] N91-32746
**OCEANOGRAPHY**
Naval arctic manual, ATP 17(A)
[PB91-193920] N91-32584
Study on observational systems: A review of meteorological and oceanographic education in observational techniques and the relationship to national facilities and needs
[PB91-198168] N91-32739
**OCEANS**
Operational SATCOM: Moving from trials to service N91-32111
ADS integration into the flight management computer N91-32114
Near-term satellite-based oceanic air traffic control: Ground system description N91-32116
Impact of automation and data link enhancements on oceanic air traffic control N91-32117
Preliminary evaluation of ADS/radar correlation N91-32119
Deriving Earth science products from SSM/I N91-32684
**ON-LINE SYSTEMS**
Comparisons of elastic and rigid blade-element rotor models using parallel processing technology for piloted simulations
[NASA-TM-102859] N91-32071
Extension of and improvements to the ERDC low frequency magnetic direction finding system N91-32708
GOOSE: A Generalized Object-Oriented Simulation Environment
[DE91-016771] N91-32842
Design of the Digital Sky Survey DA and online system: A case history in the use of computer aided tools for data acquisition system design
[DE91-016469] N91-33032
**OPEN CIRCUIT VOLTAGE**
Step voltage analysis for the catenoid lightning protection system N91-32623
**OPERATING SYSTEMS (COMPUTERS)**
Mutual exclusion
[NASA-CR-188122] N91-32822
**OPERATING TEMPERATURE**
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 1: Design and ground tests N91-32269
**OPERATIONAL PROBLEMS**
Naval arctic manual, ATP 17(A)
[PB91-193920] N91-32584
**OPERATOR PERFORMANCE**
Stochastic availability analysis of operational data systems in the Deep Space Network N91-32278
**OPERATORS (MATHEMATICS)**
Spectral element methods for the unsteady Navier-Stokes equations N91-32432
An r-matrix approach to nonstandard classes of integrable equations
[MATHS-REPT-A-149] N91-32861
**OPHTHALMOLOGY**
Publications and presentations of the Opthalmology Branch, USAF School of Aerospace Medicine, 1981-1990
[AD-A239458] N91-32754
**OPTICAL COMMUNICATION**
Spectral filters for laser communications N91-32257
Analysis of a multiple reception model for processing images from the solid-state imaging camera N91-32259
**OPTICAL EQUIPMENT**
Feedback controlled optics with wavefront compensation
[NASA-CASE-NPO-18194-1-CU] N91-32924
Interaction of InGa liquid alloy coolant with gold coated optical materials
[DE91-017480] N91-32927
**OPTICAL FIBERS**
Radiation-induced attenuation of high-OH optical fibers after hydrogen treatment in the presence of ionizing radiation
[DE91-016093] N91-32921
**OPTICAL FILTERS**
Spectral filters for laser communications N91-32257
Integrated filter and detector array for spectral imaging
[NASA-CASE-NPO-18317-1-CU] N91-32926
**OPTICAL HETERODYNING**
Refinement of a pulsed CO2-laser rangefinder with heterodyne detection
[FEL-90-A303] N91-32477
**OPTICAL MEASUREMENT**
Global lightning studies N91-32667
**OPTICAL MEASURING INSTRUMENTS**
Zonal deformable mirror for laser wavefront control
[DE91-017085] N91-32483
Fabrication of advanced x ray optics with magnetron mini-source arrays
[DE91-017093] N91-32919
**OPTICAL MEMORY (DATA STORAGE)**
Optoelectronic associative memory
[NASA-CASE-NPO-18278-1-CU] N91-32925
Identification of essential success factors for an electronic master publication library
[AD-A229624] N91-33004
**OPTICAL PROPERTIES**
The internal caustic structure of illuminated liquid droplets
[NASA-CR-187194] N91-32474
Correlation between some current parameters and optical radiation generated by 280 mm long laboratory sparks N91-32655
An overview of the electronic properties of InAs(1-x)Sb(x) strained-layer superlattices (O less than or equal to x less than or equal to 1)
[DE91-017458] N91-32976
Spectroscopic properties of Nd3+ dopant ions in phosphate laser glass
[DE91-017665] N91-32985
**OPTICAL RADAR**
Polarization effects, tasks 3 and 4
[NASA-CR-184219] N91-32221
Validation of lidar and satellite remote sensing N91-32535
Lidar measurements at Garmisch, conversion model, and midlatitude aerosol effects N91-32536
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537
A lidar equipped with photon counter for measuring stratospheric aerosols N91-32540
Atmospheric aerosol and Doppler lidar studies N91-32666
Airborne CW lidar measurements of atmospheric backscatter at 9.1 and 10.6 microns N91-32677
Computer modeling of pulsed CO2 lasers for lidar applications N91-32680
Beta measurements N91-32681
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686
**OPTICAL THICKNESS**
Aerosol sensing from balloons using photopolarimetry N91-32538
**OPTIMAL CONTROL**
Optimal control problems with switching points
[NASA-CR-4393] N91-32155
Time domain finite elements in optimal control with application to launch vehicle guidance N91-32156
Active damping using a control structure interaction approach N91-32290
Modeling and analysis of spacecraft battery charger systems N91-32411
**OPTIMIZATION**
Control design variable linking for optimization of structural/control systems N91-32144
Optimization of CMOS technology and design for deep cryogenic analog circuits N91-32296
A family of optimally conditioned quasi-Newton updates for unconstrained optimization
[MATHS-REPT-A-143] N91-32807
**OPTOELECTRONIC DEVICES**
Test on opto couplers in the linear application considering temperature, radiation and Vce effects N91-32314
Processing issues and technologies for optoelectronics-integrated circuits and devices
[DE91-017451] N91-32406
Optoelectronic associative memory
[NASA-CASE-NPO-18278-1-CU] N91-32925
**ORBIT CALCULATION**
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251
**ORBITAL POSITION ESTIMATION**
A study of geographically correlated orbit errors for Topex-incorporating GPS data N91-32154
**ORDER-DISORDER TRANSFORMATIONS**
Dynamics of surface melting
[DE91-016344] N91-32206
Ordering energy of B2 alloys calculated in the frozen potential and Harris approximations
[DE91-017228] N91-32220
X ray dichroism and Faraday effect studies in ordered and disordered Fe3Pt
[DE91-017305] N91-32974
**ORIFICES**
Uncertainty analysis of a radome flush orifice air motion system for the measurement of aircraft incident angles
[PB91-198176] N91-32133
**OSCILLATIONS**
A laser velocimeter investigation of the normal shock-wave boundary layer interaction
[NASA-TM-105201] N91-32440
Small signal gain for parabolic profile beams in free electron lasers
[DE91-016236] N91-32478
The physics of the oscillating lightning N91-32696
**OSCILLOSCOPES**
An approximate HSPICE model for orbit low noise analog bipolar NPN transistors
[DE91-017220] N91-32414
**OXIDATION**
Catalytic combustion of methane
[PB91-206391] N91-32190
New directions for the catalytic conversion of methane
[PB91-206417] N91-32191
Autoignition chemistry of C4 olefins under motored engine conditions: A comparison of experimental and modeling results
[DE91-016511] N91-32197
**OXIDATION-REDUCTION REACTIONS**
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551
The effects of platinum on nickel electrodes in the nickel hydrogen cell N91-32554
Photoinitiated electron transfer in multi-chromophoric species: Synthetic tetrads and pentads featuring diquinone moieties
[DE91-017413] N91-32896
**OXYGEN**
Effects of oxygen enrichment and fuel emulsification on diesel engine performance and emissions
[DE91-016520] N91-32506
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
**OXYGEN ATOMS**
Method for anisotropic etching in the manufacture of semiconductor devices
[NASA-CASE-MSC-21631-1] N91-32947

**OXYGEN PRODUCTION**
Electrolytic production of oxygen from lunar resources N91-32550
Space water electrolysis: Space Station through advance missions N91-32553
**OZONE**
Annular denuders for use in global climate and stratospheric measurements of acidic gases and particles N91-32531
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537
Proceedings of 2nd US/FRG Workshop on Photochemical Ozone Problem and its Control [PB91-211847] N91-32583
Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere N91-32673
Assessing the risk of chronic lung injury attributable to long-term ozone exposure [DE91-016814] N91-32757

## P

**PACIFIC OCEAN**
Tropical Pacific moisture variability N91-32690
South Pacific convergence zone and global scale circulations (Jul. 1987 - Jul. 1991). Observational and modeling studies of heat, moisture, precipitation, and global-scale circulation patterns (Jul. 1990 - Jul. 1993) N91-32691
**PACKAGES**
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) N91-32787
**PACKAGING**
Minor surgery in microgravity N91-32786
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) N91-32787
**PAINTS**
Resistance of perished paints to Skydrol [INFORME-I-536/90] N91-32223
**PAIR PRODUCTION**
A dynamical picture of hadron-hadron collisions with the string-parton model [DE91-016278] N91-32881
Ultrarelativistic atomic collisions [DE91-016768] N91-32884
Hadronic photons and collider diffractive physics [DE91-016514] N91-32888
**PARABOLIC DIFFERENTIAL EQUATIONS**
Parabolized Navier-Stokes methods for hypersonic flows N91-32433
Parabolized Navier-Stokes methods for ducted flow systems N91-32434
**PARABOLIC FLIGHT**
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
Evaluation of cardiopulmonary resuscitation techniques in microgravity N91-32789
Fluid handling 2: Surgical applications N91-32790
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility N91-32791
Precision metering of microliter volumes of biological fluids in micro-gravity N91-32792
Shuttle Orbiter medical system equipment/supplies evaluation N91-32793
**PARABOLIC REFLECTORS**
Development of a stretched-membrane dish [DE91-016499] N91-32574
**PARALLEL COMPUTERS**
On the parallel processing of Direct Simulation Monte Carlo method N91-32037
Mapping unstructured grid problems to the connection machine [NASA-CR-187719] N91-32864
**PARALLEL PROCESSING (COMPUTERS)**
On the parallel processing of Direct Simulation Monte Carlo method N91-32037
Comparisons of elastic and rigid blade-element rotor models using parallel processing technology for piloted simulations [NASA-TM-102859] N91-32071
Parallelizing the spectral transform method, part 2 [DE91-017131] N91-32456
Lanczos eigensolution method for high-performance computers [NASA-TM-104108] N91-32526
Parallel scalability of the spectral transform method [DE91-017991] N91-32744
Highly parallel computer architecture for robotic computation [NASA-CASE-NPO-17632-1-CU] N91-32805
Performance of a benchmark implementation of the Van Slyke and Wets algorithm for stochastic programs on the Alliant FX/8 [DE91-016515] N91-32833
Parallel implementation of a nonsymmetric tridiagonal eigensolver [DE91-016773] N91-32834
Gigaflop performance on a CRAY-2: Multitasking a computational fluid dynamics application [NASA-TM-4305] N91-32841
Automatic blocking of nested loops [NASA-CR-188874] N91-32844
Highly parallel sparse Cholesky factorization [NASA-CR-188875] N91-32847
A biconjugate gradient type algorithm on massively parallel architectures [NASA-CR-188888] N91-32848
Analog hardware for learning neural networks [NASA-CASE-NPO-17664-1-CU] N91-32852
Parallel computing and domain decomposition [DE91-017967] N91-32854
Empirical results of a hybrid Monte Carlo method for the solution of Poisson's equation [DE91-016240] N91-32863
Mapping unstructured grid problems to the connection machine [NASA-CR-187719] N91-32864
**PARTIAL DIFFERENTIAL EQUATIONS**
Surface grid generation based on unstructured grid N91-32042
Spline methods for conservation equations [DE91-017152] N91-32867
**PARTICLE ACCELERATION**
Excitation of nonlinear wake field in a plasma for particle acceleration [DE91-017386] N91-32945
**PARTICLE ACCELERATORS**
Computation applied to particle accelerator simulations [DE91-017128] N91-32906
**PARTICLE BEAMS**
Intense ion beam diagnostics for light ion inertial fusion experiments on PBFA 2 [DE91-017449] N91-32942
**PARTICLE COLLISIONS**
A dynamical picture of hadron-hadron collisions with the string-parton model [DE91-016278] N91-32881
Review of the heavy ion physics sessions [DE91-017828] N91-32912
**PARTICLE ENERGY**
Electron energies in metals [DE91-016759] N91-32214
**PARTICLE INTERACTIONS**
Electron energies in metals [DE91-016759] N91-32214
Single- and double-charge exchange at low pion energies [DE91-017829] N91-32901
Analogous behavior in the quantum hall effect, anyon superconductivity, and the standard model [DE91-016609] N91-32970
**PARTICLE MOTION**
Channel flow of a concentrated suspension [DE91-016649] N91-32453
The role of spin chemistry in the primary events of photosynthesis [DE91-017301] N91-32752
**PARTICLE PRODUCTION**
A unified formalism for gamma gamma to meson and psi to gammaX with possible tests for hybrid and gluonic hadrons [RAL-91-039] N91-32877
Review of the heavy ion physics sessions [DE91-017828] N91-32912
**PARTICLE THEORY**
Research program in elementary particle theory (task A) [DE91-016937] N91-32895
Particle astrophysics N91-33024
Particle theory and cosmology [DE91-017730] N91-33041
**PARTICLES**
Numerical study of Stokes flows with suspended particles [DE91-017011] N91-32455
**PARTICULATE SAMPLING**
Annular denuder systems: Precision and applicability to stratospheric sampling N91-32532
Measurements in polar stratospheric clouds over Antarctica in September 1989 N91-32534
**PARTICULATES**
Particulate models of photosynthesis [DE91-016842] N91-32751
**PARTONS**
A dynamical picture of hadron-hadron collisions with the string-parton model [DE91-016278] N91-32881
**PASCAL (PROGRAMMING LANGUAGE)**
The comparison and selection of programming languages for high energy physics applications [DE91-017130] N91-32910
**PATHOGENESIS**
Biophysical and biomathematical adventures in radiobiology [DE91-017484] N91-32750
Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] N91-32756
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] N91-32770
**PATTERN RECOGNITION**
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
Introduction to multiresolution morphology [IZF-1991-A-10] N91-32753
Recognition of simple visual images using a sparse distributed memory: Some implementations and experiments [NASA-CR-186616] N91-32797
The Cortex Transform as an image preprocessor for sparse distributed memory: An initial study [NASA-CR-187436] N91-32798
Efficient packing of patterns in sparse distributed memory by selective weighting of input bits [NASA-CR-188890] N91-32802
A VDM-SL specification for the VI pattern matcher [NPL-DITC-171/91] N91-32808
Advanced multiresolution morphology [IZF-1991-A-12] N91-32812
Saving all the bits [NASA-CR-188879] N91-32817
Distributed memory approaches for robotic neural controllers [NASA-CR-188865] N91-32859
**PAVEMENTS**
A guidebook for the control of summer heat islands [DE91-016246] N91-32586
**PAYLOAD INTEGRATION**
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals N91-32785
**PEBBLE BED REACTORS**
A nuclear thermal rocket engine design based on the particle bed reactor suitable for a Mars mission [DE91-016898] N91-32160
**PENETRATION**
Benchmark field study of deep neutron penetration [DE91-015677] N91-32886
**PERFORMANCE PREDICTION**
Flight mechanical model for performance calculations and interactions between flight vehicle and ramjet in regard to the flight orbit [DLR-FB-91-03] N91-32131
Thermodynamic flow description of a ramjet for determination of engine forces and moments [DLR-FB-91-02] N91-32139
Braun heat pump engine/compressor and its hermetic rod seal [DE91-017151] N91-32239
**PERFORMANCE TESTS**
INMARSAT access approval N91-32110
A literature review of inclusion removal by filtration and flotation [NPL-DMM(A)-13] N91-32201
Braun heat pump engine/compressor and its hermetic rod seal [DE91-017151] N91-32239
CARPET: A versatile program for radar performance analysis [FEL-91-B002] N91-32246
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 1: Design and ground tests N91-32269
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 2: Tests on the antenna N91-32270
Satellite data link validation test plan [DOT/FAA/CT-TN91/6] N91-32282
Upscreening of components for space applications N91-32376
Capability approval programme for Microwave Hybrid Integrated Circuits (MHICS) [ESA-PSS-01-612-ISSUE-1] N91-32420
Zonal deformable mirror for laser wavefront control [DE91-017085] N91-32483
Lightning protection for shuttle propulsion elements N91-32630

Influence of configuration effects on multiple burst simulation testing N91-32631
A transportable 50 kA dual mode lightning simulator N91-32633
The Sandia transportable triggered lightning instrumentation facility N91-32636
A new approach to equipment testing N91-32639
Damage to metallic samples produced by measured lightning currents N91-32640
The new Section 23 of DO160C/ED14C lightning testing of externally mounted electrical equipment N91-32716
LT-23: The feedback vibrating capacitor fieldmeter N91-32722
A simulated lightning effects test facility for testing live and inert missiles and components N91-32725
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) N91-32787
Fluid handling 2: Surgical applications N91-32790
Precision metering of microliter volumes of biological fluids in micro-gravity N91-32792
Shuttle Orbiter medical system equipment/supplies evaluation N91-32793

**PEROVSKITES**
High temperature superconductivity: The early 1991 edition
[DE91-017655] N91-32417

**PERSONNEL**
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting
[DE91-017515] N91-32758
Development of a handbook for configuration managers with applications for the program/system in full-scale development
[AD-A229617] N91-32993
Status of the profession N91-33031

**PERSONNEL MANAGEMENT**
Teaching engineers to be technical leaders
[DE91-016117] N91-33002

**PERSONNEL SELECTION**
Study of the predictive validity of a psychological selection procedure for air-traffic controllers based on training criteria
[DLR-FB-91-11] N91-32090
An investigation into the potential use of psychometric instruments for the selection of firearms officers
[CRANFIELD-AERO-9108] N91-32772

**PERTURBATION**
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components
[NASA-CR-187196] N91-32524
On the nonlinear response of minor atmospheric species to linear gravity waves N91-32593

**PHARMACOLOGY**
Prevention and treatment of motion sickness: Non-pharmacological therapy N91-32767

**PHASE ERROR**
A carrier-arraying demonstration at Goldstone for receiving Pioneer 11 signals N91-32273

**PHASE MODULATION**
Processing issues and technologies for optoelectronics-integrated circuits and devices
[DE91-017451] N91-32406

**PHASE TRANSFORMATIONS**
Laboratory and field studies of stratospheric aerosols: Phase changes under high supersaturation N91-32533
Raman spectral observation of a new phase observed in nickel electrodes cycled to failure N91-32556
Oxygen ordered superstructures and domain formation in YBa2Cu3O(7-x)
[DE90-015633] N91-32958

**PHENOLIC RESINS**
High-temperature thermomechanical behavior of carbon-phenolic and carbon-carbon composites N91-32171

**PHENOMENOLOGY**
Particle theory and cosmology
[DE91-017730] N91-33041

**PHONONS**
Inconsistencies with the single impurity Undersign model in photoelectron spectra of cerium heavy fermion compounds
[DE91-016239] N91-32878

**PHOSPHATES**
Thermal-mechanical and physical-chemical properties of phosphate laser glasses
[DE91-016604] N91-32227
Spectroscopic properties of Nd3+ dopant ions in phosphate laser glass
[DE91-017665] N91-32985

**PHOSPHORIC ACID**
The application of time-resolved luminescence spectroscopy to a remote uranyl sensor
[DE91-016310] N91-32189
Impact of fundamental technical improvements to natural gas fuel cells
[PB91-206615] N91-32570

**PHOSPHORUS COMPOUNDS**
Analysis of samples for the second (1990) round robin interlaboratory exercise
[FFI-91/6004] N91-32188

**PHOTOCATHODES**
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs)
[DE91-016196] N91-32407
The Los Alamos photoinjector-driven free-electron laser
[DE91-017824] N91-32492

**PHOTOCHEMICAL REACTIONS**
Photogenerated carrier-induced reactions on semiconductor surfaces
[DE91-017550] N91-32416
Dynamics of charge-transfer excited states relevant to photochemical energy conversion
[DE91-017710] N91-32578
Proceedings of 2nd US/FRG Workshop on Photochemical Ozone Problem and its Control
[PB91-211847] N91-32583
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588
Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere N91-32673
Photobiological investigations on spores of Streptomyces griseus
[DLR-FB-91-14] N91-32748
Particulate models of photosynthesis
[DE91-016842] N91-32751
Atmospheres of comets: Gas dynamic models and inference of kinematic parameters N91-33036
Vertical mixing and methane photochemistry in the atmosphere of Uranus: Analysis of Voyager UVS occultation experiments
[NASA-CR-188789] N91-33042

**PHOTOCONDUCTIVITY**
Wideband microwave generation with GaAs photoconductive switches
[DE91-017544] N91-32415

**PHOTOCONDUCTORS**
Wideband microwave generation with GaAs photoconductive switches
[DE91-017544] N91-32415

**PHOTODIODES**
Design and testing of an active quenching circuit for an avalanche photodiode photon detector N91-32258
Performance evaluation of new large-area avalanche photodiodes for scintillation spectroscopy
[DE91-017400] N91-32405

**PHOTOELECTRIC EMISSION**
Electron energies in metals
[DE91-016759] N91-32214

**PHOTOELECTRONS**
Inconsistencies with the single impurity Undersign model in photoelectron spectra of cerium heavy fermion compounds
[DE91-016239] N91-32878
Ion clearing and photoelectron production in the 200 MeV SXLS ring
[DE91-017156] N91-32907

**PHOTOGRAMMETRY**
Report on the photogrammetric determination of the shape of a 10m diameter microwave antenna
[NPL-MOM-103] N91-32248

**PHOTOIONIZATION**
Laser-based diagnostics for density, temperature, velocity, and dissociation fraction in high temperature hydrogen flows
[DE91-016323] N91-32480
High-intensity photoionization of H2
[DE91-017087] N91-32885

**PHOTOLUMINESCENCE**
An overview of the electronic properties of InAs(1-x)Sb(x) strained-layer superlattices (O less than or equal to x less than or equal to 1)
[DE91-017458] N91-32976

**PHOTOMETERS**
Aerosol sensing from balloons using photopolarimetry N91-32538
Integrated filter and detector array for spectral imaging
[NASA-CASE-NPO-18317-1-CU] N91-32926

**PHOTOMULTIPLIER TUBES**
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs)
[DE91-016196] N91-32407

**PHOTON-ELECTRON INTERACTION**
Coherent-state description of free-electron lasers
[DE91-017077] N91-32486

**PHOTONS**
Photon stimulated desorption from aluminum and stainless steel
[DE91-017007] N91-32211
A lidar equipped with photon counter for measuring stratospheric aerosols N91-32540
Hadronic photons and collider diffractive physics
[DE91-016514] N91-32888

**PHOTOSENSITIVITY**
The role of photosensitive polyimides in the development of hybrid space hardware N91-32321
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root
[DE91-016255] N91-32749

**PHOTOSYNTHESIS**
Particulate models of photosynthesis
[DE91-016842] N91-32751
The role of spin chemistry in the primary events of photosynthesis
[DE91-017301] N91-32752
Photoinitiated electron transfer in multi-chromophoric species: Synthetic tetrads and pentads featuring diquinone moieties
[DE91-017413] N91-32896

**PHOTOVOLTAIC CONVERSION**
Power system requirements and selection for the space exploration initiative
[DE91-016707] N91-32150

**PHYSICAL PROPERTIES**
Thermal-mechanical and physical-chemical properties of phosphate laser glasses
[DE91-016604] N91-32227

**PHYSIOLOGICAL EFFECTS**
Physical characteristics of stimuli provoking motion sickness N91-32762
Factors influencing susceptibility: Individual differences and human factors N91-32763

**PHYSIOLOGICAL RESPONSES**
Evaluation of cardiopulmonary resuscitation techniques in microgravity N91-32789

**PICOSECOND PULSES**
Picosecond time-resolved electron diffraction studies of laser heated metals
[DE91-016345] N91-32207

**PILOT TRAINING**
Aircrew part-task training research and development in the 1980s: Lessons learned
[AD-A239456] N91-32773

**PINNING**
Single vortex motion and elementary pinning force in SNIS Josephson junctions
[DE91-016160] N91-32963

**PIONS**
Single- and double-charge exchange at low pion energies
[DE91-017829] N91-32901

**PIPE FLOW**
Flow and heat transfer in a curved annular pipe N91-32055
Turbulence model calculations on the effects of body forces on turbulent flows in a pipe N91-32056
Fully developed mixed convection in a horizontal pipe N91-32057

**PIPELINING (COMPUTERS)**
Highly parallel computer architecture for robotic computation
[NASA-CASE-NPO-17632-1-CU] N91-32805

**PIPES (TUBES)**
ATLS: Catheter and tube placement N91-32782
Transport suction apparatus and absorption materials evaluation N91-32784

**PIPETTES**
Precision metering of microliter volumes of biological fluids in micro-gravity N91-32792

**PL/1**
The comparison and selection of programming languages for high energy physics applications
[DE91-017130] N91-32910

**PLANE WAVES**
Resonant triad in boundary-layer stability. Part 1: Fully nonlinear interaction
[NASA-TM-105208] N91-32458
Resonant triad in boundary-layer stability. Part 2: Composite solution and comparison with observations
[NASA-TM-105209] N91-32459
Horizontal fields generated by return strokes N91-32658

**PLANETARY ATMOSPHERES**
Planetary astronomy N91-33027

**PLANETARY WAVES**
Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere N91-32673
Laboratory and theoretical models of planetary-scale instabilities and waves N91-32675

**PLANTS (BOTANY)**
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
**PLASMA ACCELERATION**
Excitation of nonlinear wake field in a plasma for particle acceleration
[DE91-017386] N91-32945
**PLASMA ACCELERATORS**
SEPAC data analysis in support of the environmental interaction program
[NASA-CR-184201] N91-32579
**PLASMA CONTROL**
Emittance variations in current-amplifying ion induction linacs
[DE91-016266] N91-32909
H-mode physics: Experimental observations and model theories. Lecture notes
[NIFS-92] N91-32930
Geometric dependence of the scaling law on the energy confinement time in H-mode discharges
[NIFS-93] N91-32931
An H-mode-like bifurcation in core plasma of stellarators
[NIFS-97] N91-32933
Axial pressure profile effects on flute interchange stability in the tandem mirror GAMMA 10
[NIFS-98] N91-32934
Heavy Neutral Beam Probe for edge plasma analysis in tokamaks
[DE91-016290] N91-32935
L to H mode transitions and associated phenomena in divertor tokamaks
[DE91-017074] N91-32940
Beam-driven currents in the 1/nu regime in a helical system
[NIFS-27] N91-32955
Edge electric field profiles of H-mode plasmas in JFT-2M tokamak
[NIFS-26] N91-32956
**PLASMA DENSITY**
ELMy-H mode as limit cycle and chaotic oscillations in tokamak plasmas
[NIFS-96] N91-32932
High resolution measurements of density structures in the Jovian plasma sheet
[NASA-CR-188918] N91-33043
**PLASMA DIAGNOSTICS**
Visible spectroscopy diagnostics of light-ion beams
[DE91-017450] N91-32908
Advanced fusion diagnostics
[DE91-017412] N91-32941
Intense ion beam diagnostics for light ion inertial fusion experiments on PBFA 2
[DE91-017449] N91-32942
Inertial Confinement Fusion, Volume 1, Number 2
[DE91-017920] N91-32951
Radiation hardening of diagnostics
[DE91-018039] N91-32953
**PLASMA DYNAMICS**
Heavy Neutral Beam Probe for edge plasma analysis in tokamaks
[DE91-016290] N91-32935
**PLASMA ELECTRODES**
Corrosion and arc erosion in MHD channels
[DE91-016829] N91-32939
**PLASMA ENGINES**
Multimegawatt electric propulsion system design considerations
[NASA-TM-105152] N91-32164
**PLASMA HEATING**
Tuning and matching of the BPX ICH system
[DE91-017872] N91-32950
**PLASMA INTERACTIONS**
SEPAC data analysis in support of the environmental interaction program
[NASA-CR-184201] N91-32579
**PLASMA LAYERS**
High resolution measurements of density structures in the Jovian plasma sheet
[NASA-CR-188918] N91-33043
**PLASMA OSCILLATIONS**
ELMy-H mode as limit cycle and chaotic oscillations in tokamak plasmas
[NIFS-96] N91-32932
**PLASMA PHYSICS**
Macroscale implicit, electromagnetic particle simulation of inhomogeneous and magnetized plasmas in multi-dimensions
[NIFS-91] N91-32929
H-mode physics: Experimental observations and model theories. Lecture notes
[NIFS-92] N91-32930
A new variational formulation of kinetic plasma theory and the application of moving finite elements
[DE91-016072] N91-32938
Development of the stellarator/heliotron research
[NIFS-84] N91-32957
**PLASMA PROPULSION**
MPD thruster technology
[NASA-TM-105242] N91-32162
**PLASMA SHEATHS**
Self-generated stochastic heating in an RF discharge
[DE91-017404] N91-32948
**PLASMA WAVES**
Excitation of nonlinear wake field in a plasma for particle acceleration
[DE91-017386] N91-32945
Kinetic theory of RF current drive and helicity injection
[DE91-017388] N91-32946
**PLASMAS (PHYSICS)**
Surface modification of high-strength reinforcing fibers by plasma treatment
[DE91-016481] N91-32226
A global simulation of the magnetosphere with a long tail: Southward and northward IMF
[NIFS-99] N91-32592
Emittance variations in current-amplifying ion induction linacs
[DE91-016266] N91-32909
Heavy Neutral Beam Probe for edge plasma analysis in tokamaks
[DE91-016290] N91-32935
The promise of magnetized fuel: High gain in inertial confinement fusion
[DE91-016321] N91-32937
A new variational formulation of kinetic plasma theory and the application of moving finite elements
[DE91-016072] N91-32938
Development of the stellarator/heliotron research
[NIFS-84] N91-32957
**PLASTIC DEFORMATION**
Instability of shaped charged jets with general constitutive equations
[FFI-91/4004] N91-32203
**PLASTIC PROPERTIES**
Microstructural change and its influence on stress-strain behavior of two superplastic materials
[DE91-017431] N91-32980
**PLATING**
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application
[NASA-TM-103551] N91-32217
**PLATINUM**
The effects of platinum on nickel electrodes in the nickel hydrogen cell N91-32554
High energy efficiency and high power density proton exchange membrane fuel cells: Electrode kinetics and mass transport N91-32558
**PLATINUM ALLOYS**
X ray dichroism and Faraday effect studies in ordered and disordered Fe3Pt
[DE91-017305] N91-32974
**PLUTONIUM 239**
Further development of IDGS: Isotope dilution gamma-ray spectrometry
[DE91-016315] N91-32936
**PLUTONIUM 240**
Further development of IDGS: Isotope dilution gamma-ray spectrometry
[DE91-016315] N91-32936
**POINTING CONTROL SYSTEMS**
Initial pointing calibrations for the DSS 13 34-meter beam-waveguide antenna N91-32267
Modeling and simulations of the DSS 13 antenna control system N91-32268
**POISONS**
Signs and symptoms of motion sickness and its basic nature N91-32760
**POISSON EQUATION**
Empirical results of a hybrid Monte Carlo method for the solution of Poisson's equation
[DE91-016240] N91-32863
**POLAR METEOROLOGY**
International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects
[NASA-CP-3114] N91-32528
Measurements in polar stratospheric clouds over Antarctica in September 1989 N91-32534
**POLARIMETERS**
Aerosol sensing from balloons using photopolarimetry N91-32538
**POLARIMETRY**
Aerosol sensing from balloons using photopolarimetry N91-32538
**POLARITY**
On charging of snow particles in blizzard N91-32724
Experimental modelling of lightning interaction phenomena with a free potential conducting objects N91-32729
**POLARIZATION (CHARGE SEPARATION)**
On charging of snow particles in blizzard N91-32724
**POLARIZATION (SPIN ALIGNMENT)**
The role of spin chemistry in the primary events of photosynthesis
[DE91-017301] N91-32752
**POLARIZATION (WAVES)**
Analysis of polarization properties of shallow metallic gratings by an extended Rayleigh-Fano theory
[DE91-016982] N91-32835
**POLARIZATION CHARACTERISTICS**
Synthetic aperture radar imagery of airports and surrounding areas: Study of clutter at grazing angles and their polarimetric properties
[NASA-CR-4398] N91-32088
**POLARIZED ELECTROMAGNETIC RADIATION**
Circular Intensity Differential Scattering (CIDS) measurements in the soft x ray region of the spectrum (approximately 16 eV to 500 eV)
[DE91-016429] N91-32915
**POLARIZERS**
Wideband waveguide polarizer development for SETI N91-32277
**POLICE**
An investigation into the potential use of psychometric instruments for the selection of firearms officers
[CRANFIELD-AERO-9108] N91-32772
**POLICIES**
Guidelines for a proposed lightning protection policy of a golf association or tournament sponsor N91-32735
Europe 1993: The single European market and R and D policy at Krupp N91-32995
Working Papers: Astronomy and Astrophysics Panel Reports
[NASA-CR-188785] N91-33017
High energy from space N91-33023
Solar astronomy N91-33026
Policy opportunities N91-33029
**POLLUTION CONTROL**
Proceedings of 2nd US/FRG Workshop on Photochemical Ozone Problem and its Control
[PB91-211847] N91-32583
**POLLUTION MONITORING**
Sampling of atmospheric carbonyl compounds for determination by liquid chromatography after 2,4-dinitrophenylhydrazine labelling
[DE91-015842] N91-32585
Mexico City air quality research initiative: An overview and some statistical aspects
[DE91-018045] N91-32590
**POLOIDAL FLUX**
Edge electric field profiles of H-mode plasmas in JFT-2M tokamak
[NIFS-26] N91-32956
**POLYACRYLONITRILE**
Effect of lightning strike on bromine intercalated graphite fiber/epoxy composites
[NASA-TM-104507] N91-32177
**POLYAMIDE RESINS**
Advanced thermoplastic resins, phase 2
[NASA-CR-187548] N91-32231
**POLYCRYSTALS**
Electronic transport properties in copper oxides
[DE91-018182] N91-32213
**POLYETHYLENES**
Surface modification of high-strength reinforcing fibers by plasma treatment
[DE91-016481] N91-32226
**POLYIMIDE RESINS**
Addition polyimides with enhanced processability
[NASA-CASE-LEW-15043-1] N91-32230
Advanced thermoplastic resins, phase 2
[NASA-CR-187548] N91-32231
**POLYIMIDES**
The role of photosensitive polyimides in the development of hybrid space hardware N91-32321
**POLYMER BLENDS**
Krupp Technical Reports, number 2, December 1990 (English version)
[ISSN-0930-9276] N91-32994
Development of polymer alloys for electrical engineering applications N91-33000
**POLYMER MATRIX COMPOSITES**
Standards for polymer matrix composites. Part 2: Assessment and comparison of CRAG test methods
[NPL-DMM(A)-7-PT-2] N91-32174
Integrated mechanics for the passive damping of polymer-matrix composites and composite structures
[NASA-TM-104346] N91-32181
**POLYMERIC FILMS**
Development of a stretched-membrane dish
[DE91-016499] N91-32574
**POLYMERIZATION**
Addition polyimides with enhanced processability
[NASA-CASE-LEW-15043-1] N91-32230
Current status of solid-state lithium batteries employing solid redox polymerization cathodes
[DE91-016988] N91-32404

**POLYMERS**
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
Some recent studies with the solid-ionomer electrochemical capacitor N91-32562
**POLYPHENYLS**
Addition polyimides with enhanced processability [NASA-CASE-LEW-15043-1] N91-32230
**POMERANCHUK THEOREM**
Soft and hard Pomerons: Is there a distinction? [DE91-016048] N91-32883
**POMERONS**
Soft and hard Pomerons: Is there a distinction? [DE91-016048] N91-32883
**POROSITY**
Materials qualification technology for ceramic cross-flow filters [DE91-017715] N91-32232
Cryogenic cooling of x ray crystals using porous matrix [DE91-017322] N91-32982
**POROUS MATERIALS**
Shock-vaporization studies on zinc and porous carbon [DE91-017846] N91-32233
Cryogenic cooling of x ray crystals using porous matrix [DE91-017322] N91-32982
**PORPHYRINS**
Photoinitiated electron transfer in multi-chromophoric species: Synthetic tetrads and pentads featuring diquinone moieties [DE91-017413] N91-32896
**POSITION (LOCATION)**
Hardening communication ports for survival in electrical overstress environments N91-32624
The effect of the Earth's oblate spheroid shape on the accuracy of a time-of-arrival lightning ground strike locating system N91-32706
Experience gained in operation of the VLF ATD lightning location system N91-32707
Extension of and improvements to the ERDC low frequency magnetic direction finding system N91-32708
An iterative method for obtaining the optimum lightning location on a spherical surface N91-32709
Comparison of lightning location data and polarisation radar observations of clouds N91-32710
The spatial variations of lightning during small Florida thunderstorms N91-32711
**POSITION ERRORS**
A study of geographically correlated orbit errors for Topex-incorporating GPS data N91-32154
**POSITION INDICATORS**
The effect of the Earth's oblate spheroid shape on the accuracy of a time-of-arrival lightning ground strike locating system N91-32706
Experience gained in operation of the VLF ATD lightning location system N91-32707
Extension of and improvements to the ERDC low frequency magnetic direction finding system N91-32708
An iterative method for obtaining the optimum lightning location on a spherical surface N91-32709
Comparison of lightning location data and polarisation radar observations of clouds N91-32710
The spatial variations of lightning during small Florida thunderstorms N91-32711
Weak positive cloud-to-ground flashes in Northeastern Colorado N91-32712
Lightning mapping system N91-32713
**POSITIONING**
Application and use of spinal immobilization devices in zero-gravity flight N91-32781
**POSITIONING DEVICES (MACHINERY)**
Versatile, low-cost, computer-controlled, sample positioning system for vacuum applications [NASA-CR-187144] N91-32237
**POSITIVE IONS**
Multiheteromacrocycles that complex metal ions [DE91-016292] N91-32205
**POSITRON ANNIHILATION**
Fermi surface measurements in YBa2Cu3O(7-x) and La(1.874)Sr(126)CuO4 [DE91-017094] N91-32973
**POSITRONS**
Liquid and solid Ga and Bi studies with a variable energy positron beam [DE91-016910] N91-32889
**POTABLE WATER**
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
**POTASSIUM CHLORIDES**
Equations of state for solid NaCl-KCl and liquid NaCl-KCl-H2O [DE91-016980] N91-32195
**POTASSIUM HYDROXIDES**
Impedances of nickel electrodes cycled in various KOH concentrations N91-32557
**POTENTIAL ENERGY**
Ordering energy of B2 alloys calculated in the frozen potential and Harris approximations [DE91-017228] N91-32220
The physics of the oscillating lightning N91-32696
X ray absorption fine structure of systems in the anharmonic limit [DE91-016070] N91-32892
**POTENTIOMETRIC ANALYSIS**
Photoinitiated electron transfer in multi-chromophoric species: Synthetic tetrads and pentads featuring diquinone moieties [DE91-017413] N91-32896
**POWER AMPLIFIERS**
Reliability of microwave bipolar silicon transistors N91-32305
**POWER BEAMING**
Performance enhancement using power beaming for electric propulsion Earth orbital transporters [DE91-017287] N91-32168
A power beaming based infrastructure for space power [DE91-017533] N91-32169
**POWER CONDITIONING**
Neutron, gamma ray and post-irradiation thermal annealing effects on power semiconductor switches [NASA-TM-105248] N91-32410
Comparison of high temperature, high frequency core loss and dynamic B-H loops of two 50 Ni-Fe crystalline alloys and an iron-based amorphous alloy [NASA-TM-105205] N91-32412
Flywheel-powered shuttle car [PB91-200543] N91-32499
**POWER CONVERTERS**
Status of NASA's Stirling Space Power Converter Program [NASA-TM-104512] N91-32569
**POWER EFFICIENCY**
High energy efficiency and high power density proton exchange membrane fuel cells: Electrode kinetics and mass transport N91-32558
**POWER FACTOR CONTROLLERS**
Design, development, and qualification of special super N-channel MOSFET die for space applications N91-32297
**POWER LINES**
Lightning location system supervising Swedish power transmission network N91-32617
Characterization of vertical electric fields and associated voltages induced on a overhead power line from close artificially initiated lightning N91-32629
Horizontal fields generated by return strokes N91-32658
Voltages induced on a power distribution line by overhead cloud lightning N91-32734
**PRECIPITATION**
Comparison of lightning location data and polarisation radar observations of clouds N91-32710
**PRECIPITATION (METEOROLOGY)**
MAMS: High resolution atmospheric moisture/surface properties N91-32664
AMPR/SSMI data comparisons N91-32665
Global lightning studies N91-32667
Climate research system [DE91-016903] N91-32742
**PRECIPITATION HARDENING**
Effect of thermal exposure, forming, and welding on high-temperature, dispersion-strengthened aluminum alloy: Al-8Fe-1V-2Si [NASA-CR-187575] N91-32200
**PRECONDITIONING**
On polynomial preconditioning for indefinite Hermitian matrices [NASA-CR-188857] N91-32814
Multilevel filtering elliptic preconditioners [NASA-CR-188851] N91-32845
**PREDICTION ANALYSIS TECHNIQUES**
Determination of aerodynamic characteristics from ATTAS flight data gathering for ground-based simulator [DLR-FB-91-15] N91-32076
Aeroelastic loads and stability investigation of a full-scale hingeless rotor [NASA-TM-103867] N91-32134
Simulation of radiation induced circuit failure modes in SOS integrated circuits N91-32351
Irradiation tests and radiation hardness prediction considerations on electronic components for space application N91-32355
Stress states in wound capacitors [DE91-016402] N91-32400
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688
**PREDICTIONS**
Finite difference numerical prediction of aerodynamics for airfoil flying over wavy wall N91-32043
Predicting cloud-to-ground lightning with neural networks N91-32646
Power and energy dissipation in subsequent return strokes as predicted by a new return stroke model N91-32657
Noise levels of USAF aircraft in exercise Luce Belle [NPL-RSA(EXT)-16] N91-32873
**PREMIXED FLAMES**
Studies in premixed combustion [DE91-016964] N91-32198
**PREMIXING**
Investigation of radiative interactions in supersonic internal flows [NASA-CR-188820] N91-32078
**PREPREGS**
Guidelines for carbon and other advanced fibre prepreg procurement specifications [ESA-PSS-03-207-ISSUE-1] N91-32176
**PREPROCESSING**
The Cortex Transform as an image preprocessor for sparse distributed memory: An initial study [NASA-CR-187436] N91-32798
**PRESSURE DISTRIBUTION**
Navier-Stokes analysis for flowfield around hovering rotor N91-32066
An experimental study of fluctuating pressure loads beneath swept shock/boundary-layer interactions [NASA-CR-188919] N91-32080
Temporal and spectral features of wall pressure fluctuations beneath a turbulent boundary layer N91-32461
Axial pressure profile effects on flute interchange stability in the tandem mirror GAMMA 10 [NIFS-98] N91-32934
**PRESSURE EFFECTS**
Prediction techniques for jet-induced effects in hover on STOVL aircraft [NASA-TM-102818] N91-32070
Effect of initial conditions on combustion generated loads [DE91-016646] N91-32194
Thermodynamics of combustion in an enclosure [DE91-016430] N91-32992
**PRESSURE GRADIENTS**
Some current approaches in turbulence modelling N91-32446
**PRESSURE MEASUREMENT**
A comparison of the analytical and experimental performance of the solid version of a cooled radial turbine [NASA-CR-187195] N91-32077
Non-invasive pressure measuring device and method [AD-D014949] N91-32470
**PRESSURE OSCILLATIONS**
Temporal and spectral features of wall pressure fluctuations beneath a turbulent boundary layer N91-32461
**PRESSURE REDUCTION**
Withstanding voltage degradation of EEE components due to cavity pressure loss N91-32313
**PRESSURE VESSELS**
Pressure safety training [DE91-015717] N91-32238
Multiple cell common pressure vessel nickel hydrogen battery N91-32564
**PRESSURIZING**
Hot gas test results of a miniature free-piston pressurization pump driven by hydrazine decomposition products [DE91-017072] N91-32504
**PREVENTION**
Advances in lightning protection that satisfies contemporary standards N91-32731
**PRINTED CIRCUITS**
Surface mount on ceramic: How to achieve a space quality level N91-32309
Surface mount technology on PCBs at Alcatel Espace N91-32326
MTSL-005: Reliability evaluation of high pincount hermetic ceramic packages for space applications N91-32328
Low-cost 3 kV, triggered, stripline, surface-discharge switch [DE91-016641] N91-32403
The repair and modification of printed-circuit board assemblies for space use [ESA-PSS-01-728-ISSUE-2] N91-32422
**PROBABILITY THEORY**
Launch pad lightning protection effectiveness N91-32627
Experimental modelling of lightning interaction phenomena with a free potential conducting objects N91-32729
The case for lower probabilities as measures of uncertainty [DE91-017870] N91-32870

**PROCEDURES**
Test structures and measurement techniques for radiation hardening N91-32332
**PROCESS CONTROL (INDUSTRY)**
Method and apparatus for producing microshells [NASA-CASE-NPO-16635-1-CU] N91-32240
Space manufacturing quality through statistical process control: An application at Texas Instruments France, a space semiconductors production line N91-32384
Technology approval using capability indices N91-32389
Gas tungsten arc adaptive welding [DE91-017848] N91-32513
**PROCUREMENT**
Guidelines for carbon and other advanced fibre prepreg procurement specifications [ESA-PSS-03-207-ISSUE-1] N91-32176
**PROCUREMENT MANAGEMENT**
An overview of the NASA electronic components information management system N91-32369
Rationales for the selection of a parts procurement system (coordinated versus centralized) from a prime contractor point of view N91-32371
EEC component procurement: A look ahead N91-32372
NASA's challenge for tomorrow N91-32374
Parts management for the 1990's N91-32375
CPFS: The total information system tool for EEE-parts procurement N91-32379
Cost effective electronic components for short life space missions N91-32387
Evaluation of advanced microelectronics for inclusion in MIL-STD-975 N91-32390
**PROCUREMENT POLICY**
ESA Electronic Components Conference [ESA-SP-313] N91-32291
Experiences with components in the DFS-project: Seen from a customer's point of view N91-32366
Summary of EEE component anomalies encountered in the SPOT line of Earth observation satellites and lessons derived therefrom for future generations N91-32367
A statistical evaluation of EEE-parts procurement data from telecommunication satellites N91-32368
An overview of the NASA electronic components information management system N91-32369
EEC component procurement: A look ahead N91-32372
ESA's component programme plan N91-32373
NASA's challenge for tomorrow N91-32374
Parts management for the 1990's N91-32375
Technology approval using capability indices N91-32389
Evaluation of advanced microelectronics for inclusion in MIL-STD-975 N91-32390
Specification, procurement and testing of passivated microwave semiconductor chips for space applications N91-32393
**PRODUCT DEVELOPMENT**
Which position for MIL-space industry facing QML concept N91-32386
Development of a handbook for configuration managers with applications for the program/system in full-scale development [AD-A229617] N91-32993
**PRODUCTION ENGINEERING**
Experiences with components in the DFS-project: Seen from a customer's point of view N91-32366
**PRODUCTION MANAGEMENT**
Preparing electronics quality for the next century N91-32382
EQML: A chance for Europe N91-32383
Total quality management: What are the facts behind the concepts? N91-32385
Which position for MIL-space industry facing QML concept N91-32386
Technology approval using capability indices N91-32389
Progress in submicron technologies N91-32394
**PRODUCTION PLANNING**
Europe 1993: Challenge and opportunity for distribution logistics N91-32998
**PRODUCTIVITY**
Teaching engineers to be technical leaders [DE91-016117] N91-33002
**PROGRAM VERIFICATION (COMPUTERS)**
The formal verification of generic interpreters [NASA-CR-4403] N91-32853
**PROJECT MANAGEMENT**
NASA's challenge for tomorrow N91-32374
CPFS: The total information system tool for EEE-parts procurement N91-32379
Beyond formalism [NASA-CR-188886] N91-32819
Development of a handbook for configuration managers with applications for the program/system in full-scale development [AD-A229617] N91-32993
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 4: Reference information: Reference [PB91-204552] N91-33010
Theory and laboratory astrophysics N91-33025
Solar astronomy N91-33026
Planetary astronomy N91-33027
Policy opportunities N91-33029
**PROJECT PLANNING**
Satellite data link validation test plan [DOT/FAA/CT-TN91/6] N91-32282
ESA's component programme plan N91-32373
Smart instruments and the national collaboratory [NASA-CR-188902] N91-32472
Future directions of laboratory x ray laser research [DE91-017088] N91-32487
A NASA/RAE cooperation in the development of a real-time knowledge-based autopilot [NASA-TM-104234] N91-32850
Working Papers: Astronomy and Astrophysics Panel Reports [NASA-CR-188785] N91-33017
Radio astronomy N91-33018
Optical/IR from ground N91-33020
UV-optical from space N91-33021
High energy from space N91-33023
Particle astrophysics N91-33024
Theory and laboratory astrophysics N91-33025
Solar astronomy N91-33026
Planetary astronomy N91-33027
**PROP-FAN TECHNOLOGY**
Unsteady flowfield of a propfan at takeoff conditions [NASA-TM-105223] N91-32075
**PROPELLANT DECOMPOSITION**
Hot gas test results of a miniature free-piston pressurization pump driven by hydrazine decomposition products [DE91-017072] N91-32504
**PROPELLANT TANKS**
Microgravity liquid propellant management [NASA-CR-184238] N91-32236
Simulation and measurement of melting effects on metal sheets caused by direct lightning strikes N91-32644
**PROPELLANTS**
The NASA cryogenic fluid management technology program plan [NASA-TM-105256] N91-32161
**PROPELLER FANS**
Unsteady flowfield of a propfan at takeoff conditions [NASA-TM-105223] N91-32075
**PROPELLERS**
On the maximum range of flying wings [AD-A229487] N91-32130
**PROPHYLAXIS**
Motion Sickness: Significance in Aerospace Operations and Prophylaxis [AGARD-LS-175] N91-32759
**PROPULSION SYSTEM CONFIGURATIONS**
Investigation of advanced counterrotation blade configuration concepts for high speed turboprop systems. Task 3: Advanced fan section grid generator final report and computer program user's manual [NASA-CR-187129] N91-32138
Application of an integrated flight/propulsion control design methodology to a STOVL aircraft [NASA-TM-105254] N91-32143
MPD thruster technology [NASA-TM-105242] N91-32162
Performance enhancement using power beaming for electric propulsion Earth orbital transporters [DE91-017287] N91-32168
System requirements for low-Earth-orbit launch using laser propulsion [DE91-017455] N91-32490
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components [NASA-CR-187196] N91-32524
**PROPULSION SYSTEM PERFORMANCE**
On the maximum range of flying wings [AD-A229487] N91-32130
Preliminary flight evaluation of an engine performance optimization algorithm [NASA-TM-4328] N91-32140
The Navy/NASA Engine Program (NNEP89): Interfacing the program for the calculation of complex Chemical Equilibrium Compositions (CEC) [NASA-CR-187208] N91-32141
System requirements for low-Earth-orbit launch using laser propulsion [DE91-017455] N91-32490
Inherently safe nuclear-driven internal combustion engines [DE91-016568] N91-32503
Effects of oxygen enrichment and fuel emulsification on diesel engine performance and emissions [DE91-016520] N91-32506
Lightning protection for shuttle propulsion elements N91-32630
**PROSTHETIC DEVICES**
Rotationally actuated prosthetic helping hand [NASA-CASE-MFS-28426-1] N91-32795
**PROTECTION**
A survey of laser lightning rod techniques N91-32645
Discussions on a long gap discharge to an EHV transmission tower by a rocket triggered lightning experiment N91-32654
Advances in lightning protection that satisfies contemporary standards N91-32731
Circuit protection devices for transient suppression N91-32732
Evaluating lightning hazards to building environments using explicit numerical solutions of Maxwell's equations N91-32733
Guidelines for a proposed lightning protection policy of a golf association or tournament sponsor N91-32735
**PROTECTIVE COATINGS**
Silver lined ceramic vessel and method of preparation [AD-D014953] N91-32224
Ceramic coatings on smooth surfaces [NASA-CASE-LEW-15164-2] N91-32229
Inertial Confinement Fusion, Volume 1, Number 2 [DE91-017920] N91-32951
**PROTECTORS**
Circuit protection devices for transient suppression N91-32732
**PROTOCOL (COMPUTERS)**
Use of ISO protocols in the ADS environment N91-32115
**PROTON BEAMS**
Advanced high brightness ion RF accelerator applications in the nuclear energy [DE91-016075] N91-32905
**PROTON DAMAGE**
Space radiation effects on CCDs N91-32339
Further proton damage effects in EEV CCDs N91-32340
Single event effects by protons on low Earth orbits: A problem for European manned space missions N91-32349
Measurements of proton upset induced in CMOS devices: Synthesis of CEA studies N91-32356
**PROTON IRRADIATION**
Space radiation effects on CCDs N91-32339
Further proton damage effects in EEV CCDs N91-32340
Measurements of proton upset induced in CMOS devices: Synthesis of CEA studies N91-32356
Characterization of 256 Kbits SRAMs under californium 252 and protons irradiations N91-32359
Advances in SEM beam micro-irradiation N91-32360
**PROTONS**
Study of neutron-proton interaction in the 300 to 700 MeV energy region [DE91-016487] N91-32887
Fast neutron dosimetry [DE91-016907] N91-32894
**PROTOTYPES**
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility N91-32791
GOOSE: A Generalized Object-Oriented Simulation Environment [DE91-016771] N91-32842
**PROVING**
Development of procedures for verification of alleged use of chemical warfare agents: Application of procedures after a simulated attack on an air base [FFI-91/6006] N91-32148
**PSYCHOLOGICAL TESTS**
Study of the predictive validity of a psychological selection procedure for air-traffic controllers based on training criteria [DLR-FB-91-11] N91-32090
**PSYCHOMETRICS**
An investigation into the potential use of psychometric instruments for the selection of firearms officers [CRANFIELD-AERO-9108] N91-32772
**PSYCHOMOTOR PERFORMANCE**
Study of the predictive validity of a psychological selection procedure for air-traffic controllers based on training criteria [DLR-FB-91-11] N91-32090
**PUBLIC HEALTH**
Assessing the risk of chronic lung injury attributable to long-term ozone exposure [DE91-016814] N91-32757

Environment, Safety and Health Thesaurus/Dictionary [DE91-013428] N91-33012
**PULMONARY FUNCTIONS**
Evaluation of cardiopulmonary resuscitation techniques in microgravity N91-32789
**PULSE AMPLITUDE**
Calibration source for electron cyclotron emission measurements [NIFS-19] N91-32913
**PULSE COMMUNICATION**
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
**PULSE GENERATORS**
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs) [DE91-016196] N91-32407
Performance of a 10 kV, 625 kA, 85 kJ energy discharge module utilizing a solid dielectric switch [DE91-017432] N91-32409
Reliable, high repetition rate thyratron grid driver used with a magnetic modulator [DE91-016558] N91-32413
An approximate HSPiCE model for orbit low noise analog bipolar NPN transistors [DE91-017220] N91-32414
Wideband microwave generation with GaAs photoconductive switches [DE91-017544] N91-32415
A transportable 50 kA dual mode lightning simulator N91-32633
**PULSE REPETITION RATE**
Reliable, high repetition rate thyratron grid driver used with a magnetic modulator [DE91-016558] N91-32413
**PULSED LASERS**
Dynamics of surface melting [DE91-016344] N91-32206
Picosecond time-resolved electron diffraction studies of laser heated metals [DE91-016345] N91-32207
Polarization effects, tasks 3 and 4 [NASA-CR-184219] N91-32221
Refinement of a pulsed CO2-laser rangefinder with heterodyne detection [FEL-90-A303] N91-32477
Monitoring interfacial dynamics by pulsed laser techniques [DE91-016950] N91-32485
Computer modeling of pulsed CO2 lasers for lidar applications N91-32680
**PULSED RADIATION**
Beam optics of the AmPS extraction line [NIKHEF-K/AMPS/91-01] N91-32914
**PULSES**
Design criteria for a magnetic switch when used to discharge a pulse forming line [DE91-016559] N91-32402
**PUSH-PULL AMPLIFIERS**
A cooled 1- to 2-GHz balanced HEMT amplifier N91-32254
**PUSHBROOM SENSOR MODES**
Model calculations for a pushbroom stereo camera: The case of the Mars 94 High Resolution Stereo Camera (HRSC) [DLR-FB-90-57] N91-32468

## Q

**Q FACTORS**
Space manufacturing quality through statistical process control: An application at Texas Instruments France, a space semiconductors production line N91-32384
Total quality management: What are the facts behind the concepts? N91-32385
Which position for MIL-space industry facing QML concept N91-32386
**QUADRUPOLES**
Beam optics of the AmPS extraction line [NIKHEF-K/AMPS/91-01] N91-32914
**QUALIFICATIONS**
Materials qualification technology for ceramic cross-flow filters [DE91-017715] N91-32232
**QUALITY CONTROL**
ESA Electronic Components Conference [ESA-SP-313] N91-32291
CNES activities on ASIC N91-32298
Qualification strategy for multi-chip packaging for space applications N91-32312
Space qualification test and evaluation of JHU/APL designed ASICs N91-32315
Experiences with components in the DFS-project: Seen from a customer's point of view N91-32366
The history of space quality EEE parts in the United States N91-32370
Space flight components database N91-32377
The merits of an independent pre-cap inspection N91-32378
Preparing electronics quality for the next century N91-32382
EQML: A chance for Europe N91-32383
Space manufacturing quality through statistical process control: An application at Texas Instruments France, a space semiconductors production line N91-32384
Total quality management: What are the facts behind the concepts? N91-32385
Which position for MIL-space industry facing QML concept N91-32386
ABB Hafo's ESA approved capability domain for CMOS/SOS ASICs N91-32388
Is the ESA/SCC screening technique more efficient than the MIL specifications? N91-32392
The crimping of high-reliability electrical connections [ESA-PSS-01-726-ISSUE-2] N91-32421
Quality assurance of field screening [DE91-016303] N91-32582
**QUANTUM CHROMODYNAMICS**
Soft and hard Pomerons: Is there a distinction? [DE91-016048] N91-32883
Hadronic photons and collider diffractive physics [DE91-016514] N91-32888
Research program in elementary particle theory (task A) [DE91-016937] N91-32895
**QUANTUM MECHANICS**
Coherent-state description of free-electron lasers [DE91-017077] N91-32486
The role of spin chemistry in the primary events of photosynthesis [DE91-017301] N91-32752
Color transparency: Enchantment and effort [DE91-016951] N91-32890
**QUANTUM STATISTICS**
Review of the heavy ion physics sessions [DE91-017828] N91-32912
**QUANTUM THEORY**
Research program in elementary particle theory (task A) [DE91-016937] N91-32895
**QUANTUM WELLS**
Quantum well, beam deflecting surface emitting lasers [NASA-CASE-NPO-18243-1-CU] N91-32489
**QUARK MODELS**
Soft and hard Pomerons: Is there a distinction? [DE91-016048] N91-32883
**QUARKS**
A dynamical picture of hadron-hadron collisions with the string-parton model [DE91-016278] N91-32881
Baryon inhomogeneity from the cosmic quark-hadron phase transition [DE91-016608] N91-33051
**QUARTZ**
Ion implantation effects in crystalline quartz [DE91-016192] N91-32977
**QUENCHING (COOLING)**
Design and testing of an active quenching circuit for an avalanche photodiode photon detector N91-32258
**QUOTIENTS**
Parallel implementation of a nonsymmetric tridiagonal eigensolver [DE91-016773] N91-32834

## R

**RADAR ASTRONOMY**
The Telecommunications and Data Acquisition Report [NASA-CR-188813] N91-32250
**RADAR DATA**
Synthetic aperture radar imagery of airports and surrounding areas: Study of clutter at grazing angles and their polarimetric properties [NASA-CR-4398] N91-32088
Preliminary evaluation of ADS/radar correlation N91-32119
Methods for the automatic de-aliasing of the Doppler velocity of a weather radar [DLR-FB-91-08] N91-32249
Generation of topographic terrain models utilizing synthetic aperture radar and surface level data [NASA-CASE-GSC-13212-1] N91-32546
**RADAR DETECTION**
Improvement in radar detection under scan-to-scan processing and scan rate reduction N91-32245
**RADAR ECHOES**
Comparison of lightning location data and polarisation radar observations of clouds N91-32710
**RADAR IMAGERY**
Synthetic aperture radar imagery of airports and surrounding areas: Study of clutter at grazing angles and their polarimetric properties [NASA-CR-4398] N91-32088
Generation of topographic terrain models utilizing synthetic aperture radar and surface level data [NASA-CASE-GSC-13212-1] N91-32546
**RADAR MEASUREMENT**
Lidar measurements at Garmisch, conversion model, and midlatitude aerosol effects N91-32536
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537
Atmospheric aerosol and Doppler lidar studies N91-32666
Airborne CW lidar measurements of atmospheric backscatter at 9.1 and 10.6 microns N91-32677
Comparison of lightning location data and polarisation radar observations of clouds N91-32710
**RADAR NETWORKS**
VHF discharges in storm cells producing microbursts N91-32620
**RADAR RECEIVERS**
CARPET: A versatile program for radar performance analysis [FEL-91-B002] N91-32246
**RADAR SCATTERING**
Airborne CW lidar measurements of atmospheric backscatter at 9.1 and 10.6 microns N91-32677
**RADAR SIGNATURES**
Observations of Enhanced Radar Backscatter (ERB) from Millstone Hill [NASA-CR-188877] N91-32280
Range estimation techniques in single-station thunderstorm warning sensors based upon gated, wideband, magnetic direction finder technology N91-32618
**RADAR TRACKING**
Improvement in radar detection under scan-to-scan processing and scan rate reduction N91-32245
Maximum likelihood estimation applied to target motion analysis using second order derivatives [FEL-89-A193] N91-32862
**RADAR TRANSMITTERS**
CARPET: A versatile program for radar performance analysis [FEL-91-B002] N91-32246
**RADIAL FLOW**
Unsteady flowfield of a propfan at takeoff conditions [NASA-TM-105223] N91-32075
A comparison of the analytical and experimental performance of the solid version of a cooled radial turbine [NASA-CR-187195] N91-32077
**RADIATION DAMAGE**
Total dose effects on Charge Coupled Devices (CCD) reverse annealing phenomena N91-32341
Radiation assessment of complex technologies N91-32342
Radiation sensitivity of power MOSFETS N91-32344
Single event upset sensitivity of a SRAM: An overview from testing procedures to device hardening (theme 2) N91-32346
SOS material improvement for post total dose, radiation induced leakage reduction N91-32353
Total dose study on LS-, ALS, and F-technology integrated circuits N91-32354
Radiation assessment of the INMOS transputer family N91-32358
**RADIATION DETECTORS**
Lightning mapping system N91-32713
**RADIATION DISTRIBUTION**
Laser heated calcium sulfate TLD plates: Application to radiation mapping N91-32364
Observations of lightning processes using VHF radio interferometry N91-32695
A system for mapping sources of VHF and electric field pulses from in-cloud lightning at KSC N91-32697
**RADIATION DOSAGE**
Total dose effects in MOS systems: Influence of the initial hydrogen distribution N91-32338
Total dose effects on Charge Coupled Devices (CCD) reverse annealing phenomena N91-32341
Total dose study on LS-, ALS, and F-technology integrated circuits N91-32354
Advances in SEM beam micro-irradiation N91-32360
Total dose characterization of new components for the ESA radiation effects database N91-32362
Space radiation effects on power MOSFET: Threshold-voltage shift with dose rate N91-32363
Laser heated calcium sulfate TLD plates: Application to radiation mapping N91-32364
Biophysical and biomathematical adventures in radiobiology [DE91-017484] N91-32750

Intercomparison of standards of absorbed dose between the USSR and the UK
[NPL-RSA(EXT)-17] N91-32874
Initial operational experience after installation of the D3-D radiation shield
[DE91-017765] N91-32949

**RADIATION EFFECTS**
Irradiation-induced chromium depletion and its influence on integranular stress corrosion cracking of stainless steels
[DE91-017418] N91-32212
Test on opto couplers in the linear application considering temperature, radiation and Vce effects N91-32314
Total dose effects in MOS systems: Influence of the initial hydrogen distribution N91-32338
Analog CMOS/SOS in radiative environments N91-32350
Simulation of radiation induced circuit failure modes in SOS integrated circuits N91-32351
Irradiation tests and radiation hardness prediction considerations on electronic components for space application N91-32355
Measurements of proton upset induced in CMOS devices: Synthesis of CEA studies N91-32356
The pre-screening of large semiconductor memories for space application N91-32357
Radiation assessment of the INMOS transputer family N91-32358
Total dose characterization of new components for the ESA radiation effects database N91-32362
Space radiation effects on power MOSFET: Threshold-voltage shift with dose rate N91-32363
Neutron, gamma ray and post-irradiation thermal annealing effects on power semiconductor switches
[NASA-TM-105248] N91-32410
Photogenerated carrier-induced reactions on semiconductor surfaces
[DE91-017550] N91-32416
Gamma ray collimator
[NASA-CASE-SSC-00013-1] N91-32515
Biophysical and biomathematical adventures in radiobiology
[DE91-017484] N91-32750
Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography
[PB91-173351] N91-32755
Benchmark field study of deep neutron penetration
[DE91-015677] N91-32886
Circular Intensity Differential Scattering (CIDS) measurements in the soft x ray region of the spectrum (approximately 16 eV to 500 eV)
[DE91-016429] N91-32915
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy
[DE91-016571] N91-32917
Radiation-induced attenuation of high-OH optical fibers after hydrogen treatment in the presence of ionizing radiation
[DE91-016093] N91-32921
Radiation hardening of diagnostics
[DE91-018039] N91-32953
Irradiation effects in high temperature superconductors
[DE91-016118] N91-32962
Mechanisms of defect production and atomic mixing in high energy displacement cascades: A molecular dynamics study
[DE91-017082] N91-32979
Application of a thermal spike model to experimental ion-induced grain growth data
[DE91-017320] N91-32981

**RADIATION HARDENING**
The NASA Microelectronics Space Radiation Effects Program (MSREP) at the Jet Propulsion Laboratory N91-32331
Test structures and measurement techniques for radiation hardening N91-32332
Irradiation tests and radiation hardness prediction considerations on electronic components for space application N91-32355
ABB Hafo's ESA approved capability domain for CMOS/SOS ASICs N91-32388
Hardening communication ports for survival in electrical overstress environments N91-32624
Lightning testing at the subsystem level N91-32714
Radiation hardening of diagnostics
[DE91-018039] N91-32953

**RADIATION MEASUREMENT**
Environmental radioactivity measurement intercomparison exercise 1990
[NPL-RSA(EXT)-20] N91-32875

**RADIATION PROTECTION**
New technologies for integrating thermal control, and radiation protection in hybrid technology N91-32330
Space radiation effects on CCDs N91-32339
Robot development for nuclear material processing
[DE91-016567] N91-32502
Fast neutron dosimetry
[DE91-016907] N91-32894
Initial operational experience after installation of the D3-D radiation shield
[DE91-017765] N91-32949

**RADIATION SHIELDING**
Gamma ray collimator
[NASA-CASE-SSC-00013-1] N91-32515
Fast neutron dosimetry
[DE91-016907] N91-32894
Initial operational experience after installation of the D3-D radiation shield
[DE91-017765] N91-32949

**RADIATION SOURCES**
Observations of lightning processes using VHF radio interferometry N91-32695
A system for mapping sources of VHF and electric field pulses from in-cloud lightning at KSC N91-32697
Basic features of coherent radiation generated by relativistic charge bunches
[DE91-017656] N91-32898
A pulsed lepton source at LAMPF
[DE91-016010] N91-32904
Calibration source for electron cyclotron emission measurements
[NIFS-19] N91-32913

**RADIATION SPECTRA**
Correlation between some current parameters and optical radiation generated by 280 mm long laboratory sparks N91-32655

**RADIATION THERAPY**
Fast neutron dosimetry
[DE91-016907] N91-32894

**RADIATION TOLERANCE**
An 8 bit high performance ADC in silicon on sapphire N91-32302
The NASA Microelectronics Space Radiation Effects Program (MSREP) at the Jet Propulsion Laboratory N91-32331
Effects of design on total dose characteristics of ASIC technologies N91-32333
Calibration of ASIC library for radiation tolerant space applications methodology and experiment N91-32334
Radiation tolerant 1 micron CMOS technology N91-32335
Space radiation effects on CCDs N91-32339
Further proton damage effects in EEV CCDs N91-32340
Total dose effects on Charge Coupled Devices (CCD) reverse annealing phenomena N91-32341
Radiation assessment of complex technologies N91-32342
Single event test method and test results on the Intel 80386 N91-32343
Radiation sensitivity of power MOSFETS N91-32344
Trends in latch-up sensitivity N91-32345
The advantages of silicon-on-insulator technologies for space environments N91-32352
Total dose study on LS-, ALS, and F-technology integrated circuits N91-32354
Irradiation tests and radiation hardness prediction considerations on electronic components for space application N91-32355
Measurements of proton upset induced in CMOS devices: Synthesis of CEA studies N91-32356
Radiation assessment of the INMOS transputer family N91-32358
Characterization of 256 Kbits SRAMs under californium 252 and protons irradiations N91-32359
Evaluation of FPGAs N91-32361
Total dose characterization of new components for the ESA radiation effects database N91-32362

**RADIATION TRANSPORT**
Benchmark field study of deep neutron penetration
[DE91-015677] N91-32886
The essential linearity of thermal radiation net transport
[DE91-016734] N91-32990

**RADIATIVE HEAT TRANSFER**
Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere N91-32673

**RADIATIVE TRANSFER**
Infrared radiative energy transfer in gaseous systems
[NASA-CR-188925] N91-32462

**RADIO ASTRONOMY**
The Telecommunications and Data Acquisition Report
[NASA-CR-188813] N91-32250
Radio astronomy N91-33018

**RADIO COMMUNICATION**
Wide band systems N91-32242
HF systems operating beneath the ionosphere N91-32244

**RADIO DIRECTION FINDERS**
First and subsequent return stroke properties of cloud-to-ground lightning N91-32614

**RADIO FREQUENCIES**
Design and status of the RF-digitizer integrated circuit N91-32262
Results of the recent precipitation static flight test program on the Navy P-3B antisubmarine aircraft N91-32626
Advanced high brightness ion RF accelerator applications in the nuclear energy
[DE91-016075] N91-32905
Kinetic theory of RF current drive and helicity injection
[DE91-017388] N91-32946
Self-generated stochastic heating in an RF discharge
[DE91-017404] N91-32948
Tuning and matching of the BPX ICH system
[DE91-017872] N91-32950

**RADIO INTERFEROMETERS**
Observations of lightning processes using VHF radio interferometry N91-32695

**RADIO JETS (ASTRONOMY)**
Asymmetries in extragalactic radio sources N91-33050

**RADIO NAVIGATION**
Federal radionavigation plan, 1990
[PB91-190868] N91-32091
The Telecommunications and Data Acquisition Report
[NASA-CR-188813] N91-32250

**RADIO OBSERVATION**
JPL 1990-3: A 5-nrad extragalactic source catalog based on combined radio interferometric observations N91-32276
Solar-geophysical data number 560, April 1991. Part 1: (Prompt reports). Data for March, February 1991, and late data
[PB91-193508] N91-33047

**RADIOACTIVE DECAY**
A unified formalism for gamma gamma to meson and psi to gammaX with possible tests for hybrid and gluonic hadrons
[RAL-91-039] N91-32877

**RADIOACTIVE ISOTOPES**
Environmental radioactivity measurement intercomparison exercise 1990
[NPL-RSA(EXT)-20] N91-32875
The extension of the HHIRF accelerators to produce radioactive ion beams
[DE91-017687] N91-32899

**RADIOACTIVE MATERIALS**
Application of telerobotic control to remote processing of nuclear material
[DE91-016562] N91-32501
Robot development for nuclear material processing
[DE91-016567] N91-32502

**RADIOACTIVE WASTES**
Leaching behavior of microtektite glass compositions in sea water and the effect of precipitation on glass leaching
[NASA-TM-105106] N91-32225
Robot development for nuclear material processing
[DE91-016567] N91-32502
Advanced high brightness ion RF accelerator applications in the nuclear energy
[DE91-016075] N91-32905
The essential linearity of thermal radiation net transport
[DE91-016734] N91-32990

**RADIOACTIVITY**
Measurements of induced radioactivity in some LDEF samples
[DE91-016309] N91-32882

**RADIOBIOLOGY**
Biophysical and biomathematical adventures in radiobiology
[DE91-017484] N91-32750

**RADIOISOTOPE BATTERIES**
Power system requirements and selection for the space exploration initiative
[DE91-016707] N91-32150
Infrastructure for thulium-170 isotope power systems for autonomous underwater vehicle fleets
[DE91-017464] N91-32911

**RADOMES**
Uncertainty analysis of a radome flush orifice air motion system for the measurement of aircraft incident angles
[PB91-198176] N91-32133

**RAIN**
AMPR/SSMI data comparisons N91-32665
WetNet: Using SSM/I data interactively for global distribution of rainfall and precipitable water N91-32685
Precipitation regime changes associated with climatic changes
[PB91-206656] N91-32740

**RAMJET ENGINES**
Flight mechanical model for performance calculations and interactions between flight vehicle and ramjet in regard to the flight orbit
[DLR-FB-91-03] N91-32131
Thermodynamic flow description of a ramjet for determination of engine forces and moments
[DLR-FB-91-02] N91-32139

**RANDOM ACCESS MEMORY**
New developments in non-volatile semiconductor memory technologies and devices N91-32295
Single event upset sensitivity of a SRAM: An overview from testing procedures to device hardening (theme 2) N91-32346
SOS material improvement for post total dose, radiation induced leakage reduction N91-32353
Characterization of 256 Kbits SRAMs under californium 252 and protons irradiations N91-32359

**RANDOM NOISE**
Coding gains and error rates from the Big Viterbi Decoder N91-32264

**RANDOM PROCESSES**
Mode-stirred chamber field statistics: Correlation widths
[DE91-016190] N91-32289
Hamiltonian chaos and transport in quasigeostrophic flows
[DE91-017385] N91-32464

**RANDOM VARIABLES**
Mode-stirred chamber field statistics: Correlation widths
[DE91-016190] N91-32289

**RANGEFINDING**
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251
Lightning mapping system N91-32713

**RARE EARTH ELEMENTS**
Magneto-optical record media
[DE91-017838] N91-32476

**RAREFACTION**
Shock-vaporization studies on zinc and porous carbon
[DE91-017846] N91-32233

**RAREFIED GAS DYNAMICS**
Reciprocity theory of binary inelastic encounters
[IC-AERO-89-03] N91-32425

**RAREFIED GASES**
Rarefied gas numerical wind tunnel 6: Delta wing N91-32039
Solution of perfect gas viscous flows via compressible Navier-Stokes equations with wallslip conditions
[ONERA-RSF-13/3637-AY] N91-32435

**RAWINSONDES**
NOAA backscatter studies N91-32679

**RAY TRACING**
Feedback controlled optics with wavefront compensation
[NASA-CASE-NPO-18194-1-CU] N91-32924

**RAYLEIGH-BENARD CONVECTION**
Numerical simulation of thermal convection in a rectangular duct flow N91-32062

**RAYLEIGH-RITZ METHOD**
Parallel implementation of a nonsymmetric tridiagonal eigensolver
[DE91-016773] N91-32834

**RC CIRCUITS**
Design and evaluation of a GaAs MMIC X-band active RC quadrature power divider
[FEL-91-A076] N91-32396

**RCA SATCOM SATELLITES**
French SATCOM program and related international activities N91-32102

**REACTING FLOW**
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics
[NAL-SP-14] N91-32032
Numerical calculation of flow for scramjet engine N91-32035
Numerical simulations of chemically reacting flow N91-32036
Investigation of radiative interactions in supersonic internal flows
[NASA-CR-188820] N91-32078
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441

**REACTION KINETICS**
Catalytic combustion of methane
[PB91-206391] N91-32190
High octane ethers from synthesis gas-derived alcohols
[DE91-016596] N91-32193
Autoignition chemistry of C4 olefins under motored engine conditions: A comparison of experimental and modeling results
[DE91-016511] N91-32197
Reaction sintering of ZnO-Al2O3
[DE91-016254] N91-32210
Evidence for SF4 and SF2 formation in SF6 corona discharges
[DE91-015927] N91-32285
Photoinitiated electron transfer in multi-chromophoric species: Synthetic tetrads and pentads featuring diquinone moieties
[DE91-017413] N91-32896
Oxygen ordered superstructures and domain formation in YBa2Cu3O(7-x)
[DE90-015633] N91-32958

**REACTION PRODUCTS**
High octane ethers from synthesis gas-derived alcohols
[DE91-016596] N91-32193

**REACTIVITY**
Catalytic combustion of methane
[PB91-206391] N91-32190
Photobiological investigations on spores of Streptomyces griseus
[DLR-FB-91-14] N91-32748
Crossed beams studies of nonadiabatic collision dynamics
[DE91-016250] N91-32879

**REACTOR DESIGN**
A nuclear thermal rocket engine design based on the particle bed reactor suitable for a Mars mission
[DE91-016898] N91-32160

**REACTOR MATERIALS**
Orr-Sherby-Dorn creep strengths of the refractory-metal alloys C-103, ASTAR-811C, W-5Re, and W-25Re
[NASA-TM-105228] N91-32165
Corrosion and arc erosion in MHD channels
[DE91-016829] N91-32939

**READ-ONLY MEMORY DEVICES**
New developments in non-volatile semiconductor memory technologies and devices N91-32295
Recognition of simple visual images using a sparse distributed memory: Some implementations and experiments
[NASA-CR-186616] N91-32797
Identification of essential success factors for an electronic master publication library
[AD-A229624] N91-33004

**REAGENTS**
Multiheteromacrocycles that complex metal ions
[DE91-016292] N91-32205

**REAL TIME OPERATION**
Time domain finite elements in optimal control with application to launch vehicle guidance N91-32156
Thunderstorm monitoring and lightning warning, operational applications of the Safir system N91-32619
Lightning mapping system N91-32713
A NASA/RAE cooperation in the development of a real-time knowledge-based autopilot
[NASA-TM-104234] N91-32850

**RECEIVERS**
The Advanced Receiver II telemetry test results at Goldstone N91-32260
Symbol lock detection in the ARX 2 and Block 5 receivers N91-32261
Carrier-to-noise power estimation for the Block 5 Receiver N91-32275
The essential linearity of thermal radiation net transport
[DE91-016734] N91-32990

**RECHARGING**
Oxygen electrodes for rechargeable alkaline fuel cells, 3 N91-32561

**RECIPROCITY THEOREM**
Reciprocity theory of binary inelastic encounters
[IC-AERO-89-03] N91-32425

**RECOMBINATION REACTIONS**
A study of the magnetosphere-ionosphere coupling processes N91-32595

**RECONNAISSANCE**
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada
[NASA-CR-183493] N91-32591
Military robotics technologies at Sandia National Laboratories
[DE91-016113] N91-32858

**REDUCED GRAVITY**
Microgravity liquid propellant management
[NASA-CR-184238] N91-32236
Health maintenance facility: Dental equipment requirements N91-32777
Dental equipment test during zero-gravity flight N91-32778
Mini-rack testbed evaluation N91-32779
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
Application and use of spinal immobilization devices in zero-gravity flight N91-32781
Transport suction apparatus and absorption materials evaluation N91-32784
Evaluation of cardiopulmonary resuscitation techniques in microgravity N91-32789
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility N91-32791
Precision metering of microliter volumes of biological fluids in micro-gravity N91-32792
Deployment and testing of a second prototype expandable surgical chamber in microgravity N91-32794

**REDUNDANCY**
Reliability and cost: A sensitivity analysis
[NASA-TM-105293] N91-33014

**REENTRY TRAJECTORIES**
RV strings of maximum curvature
[DE91-016708] N91-32157

**REENTRY VEHICLES**
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034
RV strings of maximum curvature
[DE91-016708] N91-32157

**REFLECTANCE**
An optical multichannel analyser based large volume reflectometer
[BCRS-90-37] N91-32469
Distortion free projection lithography
[DE91-016570] N91-32916

**REFLECTION**
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy
[DE91-016571] N91-32917

**REFLECTOMETERS**
An optical multichannel analyser based large volume reflectometer
[BCRS-90-37] N91-32469

**REFLECTORS**
Method and apparatus for phasing segmented mirror arrays
[NASA-CASE-NPO-18095-1-CU] N91-32923

**REFRACTIVITY**
Aerosol sensing from balloons using photopolarimetry N91-32538

**REFRACTORY MATERIALS**
Projects within the Center for Advanced Materials
[PB91-205716] N91-32178
Advanced thermoplastic resins, phase 2
[NASA-CR-187548] N91-32231

**REFRACTORY METAL ALLOYS**
Orr-Sherby-Dorn creep strengths of the refractory-metal alloys C-103, ASTAR-811C, W-5Re, and W-25Re
[NASA-TM-105228] N91-32165

**REFRIGERANTS**
Advantages of enthalpy-temperature diagrams for nonazeotropic refrigerant mixtures
[DE91-016774] N91-32991

**REFRIGERATING**
Advantages of enthalpy-temperature diagrams for nonazeotropic refrigerant mixtures
[DE91-016774] N91-32991

**REGENERATIVE FUEL CELLS**
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
Regenerative fuel cell architectures for lunar surface power N91-32560
Oxygen electrodes for rechargeable alkaline fuel cells, 3 N91-32561

**REGOLITH**
Mining technology for lunar resource utilization
[PB91-201020] N91-33044

**REGULATIONS**
Certification of lightning protection for a full-authority digital engine control N91-32718

**REINFORCEMENT**
Advances in the design of toughened ceramics
[DE91-016767] N91-32228

**REINFORCING FIBERS**
Surface modification of high-strength reinforcing fibers by plasma treatment
[DE91-016481] N91-32226

**RELATIVISTIC PARTICLES**
Ultrarelativistic atomic collisions
[DE91-016768] N91-32884
Basic features of coherent radiation generated by relativistic charge bunches
[DE91-017656] N91-32898

**RELAXATION METHOD (MATHEMATICS)**
Parallel implementation of a nonsymmetric tridiagonal eigensolver
[DE91-016773] N91-32834
**RELAY SATELLITES**
Millimeter wavelength communications applications for the SEI
[NASA-TM-105275] N91-32287
**RELIABILITY**
Space silicon diodes: A survey of available technologies and related manufacturing and reliability aspects N91-32320
**RELIABILITY ANALYSIS**
ESA Electronic Components Conference
[ESA-SP-313] N91-32291
Development of semiconductor test structures for reliability evaluation N91-32292
New developments in non-volatile semiconductor memory technologies and devices N91-32295
Selection strategy and reliability assessment for SILEX-communication laser diodes N91-32306
Spacecraft power system concerns regarding failure modes within complex integrated circuits and hybrid packages N91-32308
A new approach to the reliability of electronic material systems N91-32310
Assessment of p-metallisations for high power GaAs laser diodes N91-32316
Space silicon diodes: A survey of available technologies and related manufacturing and reliability aspects N91-32320
Bipolar microwave transistor technology N91-32324
MTSL-005: Reliability evaluation of high pincount hermetic ceramic packages for space applications N91-32328
A solid state mass memory for space applications: Technological and system aspects N91-32329
Effects of design on total dose characteristics of ASIC technologies N91-32333
Radiation assessment of complex technologies N91-32342
Upscreening of components for space applications N91-32376
Component field failure data base N91-32380
A plan of NASDA's parts database in the reliability information system N91-32381
Development and operation of a solid-state switch for thyratron replacement
[DE91-016553] N91-32401
The crimping of high-reliability electrical connections
[ESA-PSS-01-726-ISSUE-2] N91-32421
**RELIABILITY ENGINEERING**
Development of semiconductor test structures for reliability evaluation N91-32292
New developments in non-volatile semiconductor memory technologies and devices N91-32295
Design, development, and qualification of special super N-channel MOSFET die for space applications N91-32297
Assessment of DFT strategies N91-32301
An advanced testability concept for space applications N91-32323
NASA's challenge for tomorrow N91-32374
Reliability and cost: A sensitivity analysis
[NASA-TM-105293] N91-33014
**RELIEF MAPS**
Contour-map encoding of shape for early vision
[NASA-CR-188937] N91-32545
**REMOTE CONTROL**
Versatile, low-cost, computer-controlled, sample positioning system for vacuum applications
[NASA-CR-187144] N91-32237
A generalized compliant motion primitive
[NASA-CASE-NPO-18134-1-CU] N91-32510
**REMOTE HANDLING**
Application of telerobotic control to remote processing of nuclear material
[DE91-016562] N91-32501
Robot development for nuclear material processing
[DE91-016567] N91-32502
**REMOTE SENSING**
The application of time-resolved luminescence spectroscopy to a remote uranyl sensor
[DE91-016310] N91-32189
Propagation Limitations for Systems Using Band-Spreading
[AGARD-LS-172] N91-32241
Model calculations for a pushbroom stereo camera: The case of the Mars 94 High Resolution Stereo Camera (HRSC)
[DLR-FB-90-57] N91-32468
Smart instruments and the national collaboratory
[NASA-CR-188902] N91-32472
Automatic land-use classification using LANDSAT-5 thematic mapper data in a region of the Itzehoer Geest. An attempt to improve mapping by combination with panchromatic SPOT data
[DLR-FB-90-47] N91-32542
Parametric rectification of thematic mapper raw data
[DLR-FB-90-55] N91-32543
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada
[NASA-CR-183493] N91-32591
The physics and instrumentation of passive atmospheric sounding: A review of the methods of remote sensing of temperature and moisture in the Earth's lower atmosphere
[ESA-STR-231] N91-32597
Global water cycle N91-32661
Interactive access and management for four-dimensional environmental data sets using McIDAS N91-32670
Remote sensing of water vapor features N91-32682
**REMOTE SENSORS**
The application of time-resolved luminescence spectroscopy to a remote uranyl sensor
[DE91-016310] N91-32189
Validation of lidar and satellite remote sensing N91-32535
The physics and instrumentation of passive atmospheric sounding: A review of the methods of remote sensing of temperature and moisture in the Earth's lower atmosphere
[ESA-STR-231] N91-32597
Global water cycle N91-32661
MAMS: High resolution atmospheric moisture/surface properties N91-32664
**RENDEZVOUS TRAJECTORIES**
Optimal cooperative time-fixed impulsive rendezvous N91-32153
**REQUIREMENTS**
An example of requirements for Advanced Subsonic Civil Transport (ASCT) flight control system using structured techniques
[NASA-CR-187526] N91-32132
The crimping of high-reliability electrical connections
[ESA-PSS-01-726-ISSUE-2] N91-32421
**RESEARCH AIRCRAFT**
Determination of aerodynamic characteristics from ATTAS flight data gathering for ground-based simulator
[DLR-FB-91-15] N91-32076
**RESEARCH AND DEVELOPMENT**
Satellite data link research and development program in Japan N91-32108
MPD thruster technology
[NASA-TM-105242] N91-32162
CECIL: Collaboration between companies and research agencies in heavy ion test of spacecraft microelectronics N91-32348
Progress in submicron technologies N91-32394
Energy and technology review
[DE91-016873] N91-32572
Krupp Technical Reports, number 2, December 1990 (English version)
[ISSN-0930-9276] N91-32994
Europe 1993: The single European market and R and D policy at Krupp N91-32995
The role of Krupp Forschungsinstitut in international R and D cooperation N91-32996
Know-how for Europe N91-32997
Finiteness: On constraints of applied research
[DLR-MITT-91-06] N91-33001
The decade of discovery in astronomy and astrophysics
[NASA-CR-188226] N91-33016
Radio astronomy N91-33018
Infrared astronomy N91-33019
Optical/IR from ground N91-33020
UV-optical from space N91-33021
Status of the profession N91-33031
**RESEARCH FACILITIES**
Radio astronomy N91-33018
**RESEARCH MANAGEMENT**
Smart instruments and the national collaboratory
[NASA-CR-188902] N91-32472
The decade of discovery in astronomy and astrophysics
[NASA-CR-188226] N91-33016
Working Papers: Astronomy and Astrophysics Panel Reports
[NASA-CR-188785] N91-33017
Radio astronomy N91-33018
Optical/IR from ground N91-33020
UV-optical from space N91-33021
High energy from space N91-33023
Particle astrophysics N91-33024
Theory and laboratory astrophysics N91-33025
Solar astronomy N91-33026
Planetary astronomy N91-33027
Status of the profession N91-33031
Particle theory and cosmology
[DE91-017730] N91-33041
Earth sciences report, 1989 - 1990
[DE91-017132] N91-33053
**RESEARCH PROJECTS**
Aeronautical mobile satellite services ESA-PRODAT/SITA AIRCOM service trials programme N91-32106
Satellite data link research and development program in Japan N91-32108
Future directions of laboratory x ray laser research
[DE91-017088] N91-32487
Gulf of Mexico circulation modeling study: Annual progress report: Years 3 and 4
[PB91-210666] N91-32746
A NASA/RAE cooperation in the development of a real-time knowledge-based autopilot
[NASA-TM-104234] N91-32850
The decade of discovery in astronomy and astrophysics
[NASA-CR-188226] N91-33016
Working Papers: Astronomy and Astrophysics Panel Reports
[NASA-CR-188785] N91-33017
Radio astronomy N91-33018
Optical/IR from ground N91-33020
UV-optical from space N91-33021
High energy from space N91-33023
Particle astrophysics N91-33024
Particle theory and cosmology
[DE91-017730] N91-33041
**RESIDUAL STRESS**
A study of fracture mechanisms in ATD roller bearing
[NASA-CR-184200] N91-32497
Simplified micromechanical equations for thermal residual stress analysis of coated fiber composites
[NASA-CR-187599] N91-32527
Graphite-metal brazing for thermal applications
[DE91-016647] N91-32944
**RESIN MATRIX COMPOSITES**
High-temperature thermomechanical behavior of carbon-phenolic and carbon-carbon composites N91-32171
**RESONANCE**
Resonant triad in boundary-layer stability. Part 2: Composite solution and comparison with observations
[NASA-TM-105209] N91-32459
Giant resonances in single and double charge exchange
[DE91-017822] N91-32900
**RESONANCE SCATTERING**
Soft x ray magnetic scattering study of thin films and multilayers
[DE91-017472] N91-32920
**RESOURCES**
SERI Solar Radiation Resource Assessment Project
[DE91-002164] N91-32575
**RESOURCES MANAGEMENT**
Wind energy potential in the United States considering environmental and land-use exclusions
[DE91-017535] N91-32577
Defense Logistic Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 1: Agency-wide plan IRM summary information: Agency
[PB91-204529] N91-33007
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 2: Individual organizational IRM plans: Organizations
[PB91-204537] N91-33008
Defense Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 3: Information systems/projects/programs/acquisitions: Catalogue
[PB91-204545] N91-33009
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 4: Reference information: Reference
[PB91-204552] N91-33010
**RESPIRATION**
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770
**RESPIRATORY SYSTEM**
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770
**RESUSCITATION**
Medical evaluations on the KC-135 1990 flight report summary
[NASA-TM-104740] N91-32776

Evaluation of cardiopulmonary resuscitation techniques in microgravity N91-32789
**RETINA**
An analog retina model for detecting moving objects against a moving background
[DE91-017428] N91-32544
**RETURN TO EARTH SPACE FLIGHT**
Rosetta/CNSR: A comet-nucleus sample-return mission and system definition document
[ESA-SP-1125] N91-32152
**REUSE**
To what extent can Renewable Energy (RE) systems replace carbon-based fuels in the next 15, 50, and 100 years? Eight answers
[DLR-MITT-91-04] N91-32568
**REVERBERATION CHAMBERS**
Mode-stirred chamber field statistics: Correlation widths
[DE91-016190] N91-32289
**REYNOLDS STRESS**
Some current approaches in turbulence modelling N91-32446
Appraisal of the suitability of turbulence models in flow calculations: A UK view on turbulence models for turbulent shear flow calculations N91-32450
**RIGID ROTORS**
Comparisons of elastic and rigid blade-element rotor models using parallel processing technology for piloted simulations
[NASA-TM-102859] N91-32071
Aeroelastic loads and stability investigation of a full-scale hingeless rotor
[NASA-TM-103867] N91-32134
**RING STRUCTURES**
I-BIEM calculations of the frequency dispersion and AC current distribution at disk and ring-disk electrodes N91-32559
**RISK**
Interaction of extremely-low-frequency electromagnetic fields with humans
[DE91-015779] N91-32756
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770
**ROBOT ARMS**
Dynamics modeling and control of a flexible robot arm N91-32495
A reference model dynamics-CMAC algorithm for simulation and control of robotic manipulators N91-32507
Telerobot control system
[NASA-CASE-NPO-18116-1-CU] N91-32509
A generalized compliant motion primitive
[NASA-CASE-NPO-18134-1-CU] N91-32510
A magneto-sensitive skin for robots in space
[NASA-CR-188956] N91-32512
Development of a sensor coordinated kinematic model for neural network controller training
[NASA-CR-188864] N91-32799
Distributed memory approaches for robotic neural controllers
[NASA-CR-188865] N91-32859
**ROBOT DYNAMICS**
Development of a sensor coordinated kinematic model for neural network controller training
[NASA-CR-188864] N91-32799
**ROBOT SENSORS**
A magneto-sensitive skin for robots in space
[NASA-CR-188956] N91-32512
**ROBOTICS**
A generalized compliant motion primitive
[NASA-CASE-NPO-18134-1-CU] N91-32510
Development of a sensor coordinated kinematic model for neural network controller training
[NASA-CR-188864] N91-32799
Military robotics technologies at Sandia National Laboratories
[DE91-016113] N91-32858
**ROBOTS**
Application of telerobotic control to remote processing of nuclear material
[DE91-016562] N91-32501
Robot development for nuclear material processing
[DE91-016567] N91-32502
Telerobot control system
[NASA-CASE-NPO-18116-1-CU] N91-32509
A generalized compliant motion primitive
[NASA-CASE-NPO-18134-1-CU] N91-32510
A magneto-sensitive skin for robots in space
[NASA-CR-188956] N91-32512
Military robotics technologies at Sandia National Laboratories
[DE91-016113] N91-32858
**ROCK MECHANICS**
Constitutive modeling of salt behavior: State of the technology
[DE91-017459] N91-32199
**ROCKET ENGINE DESIGN**
A nuclear thermal rocket engine design based on the particle bed reactor suitable for a Mars mission
[DE91-016898] N91-32160
Fiber-optic applications for space-based engines
[NASA-TM-105235] N91-32163
Multimegawatt electric propulsion system design considerations
[NASA-TM-105152] N91-32164
**ROCKET ENGINES**
Comparison of kinetic, equilibrium, and frozen rocket expansion obtained at different propulsive parameters for launcher and spacecraft engines
[DLR-MITT-91-02] N91-32159
System requirements for low-Earth-orbit launch using laser propulsion
[DE91-017455] N91-32490
**ROCKET EXHAUST**
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656
**ROCKET LAUNCHING**
The electric field changes and UHF radiations caused by the triggered lightning in Japan N91-32652
**ROCKET NOZZLES**
Nozzle fabrication technique
[NASA-CASE-MSC-21299-2] N91-32508
**ROCKET PROPELLANTS**
Comparison of kinetic, equilibrium, and frozen rocket expansion obtained at different propulsive parameters for launcher and spacecraft engines
[DLR-MITT-91-02] N91-32159
MPD thruster technology
[NASA-TM-105242] N91-32162
**ROCKET VEHICLES**
Discussions on a long gap discharge to an EHV transmission tower by a rocket triggered lightning experiment N91-32654
**RODS**
Instability of shaped charged jets with general constitutive equations
[FFI-91/4004] N91-32203
Braun heat pump engine/compressor and its hermetic rod seal
[DE91-017151] N91-32239
Mathematical models for determining the protected spaces of the vertical lightning rod N91-32634
A survey of laser lightning rod techniques N91-32645
High current pulse testing for ground rod integrity N91-32737
**ROLLER BEARINGS**
A study of fracture mechanisms in ATD roller bearing
[NASA-CR-184200] N91-32497
**ROLLERS**
Linear mass actuator
[NASA-CASE-LAR-14352-1] N91-32511
**ROTARY STABILITY**
Nonlinear dynamic analysis of flexible multibody systems
[NASA-CR-187597] N91-32519
**ROTARY WING AIRCRAFT**
Rotorcraft master plan
[AD-A239444] N91-32081
Aeroelastic loads and stability investigation of a full-scale hingeless rotor
[NASA-TM-103867] N91-32134
Failure mechanisms and prediction in advanced composite materials N91-32184
**ROTARY WINGS**
Analysis of the aerodynamic performance of counter-rotating propeller by means of vortex lattice method N91-32065
**ROTATING BODIES**
Developing laminar flow and heat transfer in orthogonally rotating square ducts N91-32054
Turbulence model calculations on the effects of body forces on turbulent flows in a pipe N91-32056
**ROTATING DISKS**
I-BIEM calculations of the frequency dispersion and AC current distribution at disk and ring-disk electrodes N91-32559
**ROTATION**
Linear mass actuator
[NASA-CASE-LAR-14352-1] N91-32511
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525
Rotationally actuated prosthetic helping hand
[NASA-CASE-MFS-28426-1] N91-32795
Three dimensional moire pattern alignment
[NASA-CASE-MSC-21416-1] N91-32922
**ROTOR AERODYNAMICS**
Comparisons of elastic and rigid blade-element rotor models using parallel processing technology for piloted simulations
[NASA-TM-102859] N91-32071
Analysis of rotorwash effects in helicopter mishaps
[DOT/FAA/RD-90/17] N91-32086
Aeroelastic loads and stability investigation of a full-scale hingeless rotor
[NASA-TM-103867] N91-32134
**ROTOR BLADES**
Comparisons of elastic and rigid blade-element rotor models using parallel processing technology for piloted simulations
[NASA-TM-102859] N91-32071
**ROTOR BODY INTERACTIONS**
Nonlinear dynamic analysis of flexible multibody systems
[NASA-CR-187597] N91-32519
**ROTOR DYNAMICS**
Nonlinear dynamic analysis of flexible multibody systems
[NASA-CR-187597] N91-32519
**ROTORCRAFT AIRCRAFT**
Comparisons of elastic and rigid blade-element rotor models using parallel processing technology for piloted simulations
[NASA-TM-102859] N91-32071
**ROTORS**
Navier-Stokes analysis for flowfield around hovering rotor N91-32066
**RUN TIME (COMPUTERS)**
Lanczos eigensolution method for high-performance computers
[NASA-TM-104108] N91-32526

## S

**SAFETY**
Pressure safety training
[DE91-015717] N91-32238
Environment, Safety and Health Thesaurus/Dictionary
[DE91-013428] N91-33012
**SAFETY FACTORS**
Flywheel-powered shuttle car
[PB91-200543] N91-32499
Lightning location system supervising Swedish power transmission network N91-32617
Step voltage analysis for the catenoid lightning protection system N91-32623
The new Section 23 of DO160C/ED14C lightning testing of externally mounted electrical equipment N91-32716
**SALINITY**
Fluid dynamics of double diffusive systems
[DE91-017401] N91-32465
**SALT BEDS**
Constitutive modeling of salt behavior: State of the technology
[DE91-017459] N91-32199
**SAMPLERS**
Annular denuder systems: Precision and applicability to stratospheric sampling N91-32532
**SAMPLING**
Sampling of atmospheric carbonyl compounds for determination by liquid chromatography after 2,4-dinitrophenylhydrazine labelling
[DE91-015842] N91-32585
Precision metering of microliter volumes of biological fluids in micro-gravity N91-32792
**SANDWICH STRUCTURES**
Composite-faced sandwich construction for primary spacecraft structures N91-32170
**SAPPHIRE**
Formation and annealing behavior of an amorphous layer induced by tin implantation into sapphire
[DE91-015929] N91-32960
**SATELLITE COMMUNICATION**
The First Annual International Satellite Surveillance and Communication Symposium
[DOT/FAA/RD-91/21] N91-32093
Automatic Dependent Surveillance (ADS) Program summary N91-32094
Satellite Communications (SATCOM) N91-32095
International Civil Aviation Organization (ICAO) Automatic Dependent Surveillance Panel (ADSP) activities N91-32097
International program summary N91-32098
Automatic dependent surveillance Pacific engineering trials N91-32099
ADS (Automatic Dependent Surveillance) PET (Pacific Engineering Trial) program in Japan N91-32100
Australian experiments in Automatic Dependent Surveillance (ADS) including the Pacific Engineering Trials (PET) N91-32101

French SATCOM program and related international activities N91-32102
Digitized voice trials N91-32103
ADS communications: A cornerstone N91-32105
Aeronautical mobile satellite services ESA-PRODAT/SITA AIRCOM service trials programme N91-32106
Aeronautical Mobile Satellite Service (AMSS) message and voice access request transit delay N91-32107
Satellite data link research and development program in Japan N91-32108
System improvements identified by the North Atlantic Systems Planning Group (NAT/SPG) as related to the capabilities of the Oceanic Display and Planning System (ODAPS) N91-32109
INMARSAT access approval N91-32110
The FAA/ARINC initial implementation of AMSS N91-32112
SITA satellite air communications implementation N91-32113
US oceanic air traffic control: Past, present, and future N91-32118
Operational oceanic air traffic control using satellite data link: Initial implementation N91-32121
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
Satellite surveillance and communications airline benefits: The telephone myth N91-32124
Communications needs of the future air-ground interface N91-32125
Satellite data link validation test plan [DOT/FAA/CT-TN91/6] N91-32282

**SATELLITE IMAGERY**
Global lightning studies N91-32667

**SATELLITE NETWORKS**
Operational SATCOM: Moving from trials to service N91-32111
ADS integration into the flight management computer N91-32114
Use of ISO protocols in the ADS environment N91-32115
Preliminary evaluation of ADS/radar correlation N91-32119
Efficiency calibration of the DSS 13 34-meter diameter beam waveguide antenna at 8.45 and 32 GHz N91-32271

**SATELLITE OBSERVATION**
Validation of lidar and satellite remote sensing N91-32535
NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review [NASA-CP-3126] N91-32660
AMPR/SSMI data comparisons N91-32665
NOAA backscatter studies N91-32679
Tropical Pacific moisture variability N91-32690
Severe thunderstorm cases of July 1989 thru June 1990 [PB91-201392] N91-32738

**SATELLITE ORBITS**
A study of geographically correlated orbit errors for Topex-incorporating GPS data N91-32154

**SATELLITE TRACKING**
A study of geographically correlated orbit errors for Topex-incorporating GPS data N91-32154

**SATELLITES**
A power beaming based infrastructure for space power [DE91-017533] N91-32169

**SCALE MODELS**
Spectral transfer analysis for subgrid-scale modelling N91-32438
Scale-model charge-transfer technique for measuring enhancement factors N91-32651

**SCALING**
Scaling behavior of the fluctuations in magnetization and conductivity of untwinned YBa2Cu3O(7-delta) [DE91-016524] N91-32967

**SCALING LAWS**
Geometric dependence of the scaling law on the energy confinement time in H-mode discharges [NIFS-93] N91-32931

**SCANNERS**
Measurement of interfacial area using four sensor probe in two phase flow [DE91-017415] N91-32466
Distortion free projection lithography [DE91-016570] N91-32916

**SCANNING**
Improvement in radar detection under scan-to-scan processing and scan rate reduction N91-32245

**SCATTERING**
Crossed beams studies of nonadiabatic collision dynamics [DE91-016250] N91-32879
Single- and double-charge exchange at low pion energies [DE91-017829] N91-32901
Specular and diffuse scattering studies of multilayer interfaces [DE91-016893] N91-32978

**SCATTERING AMPLITUDE**
A dynamical picture of hadron-hadron collisions with the string-parton model [DE91-016278] N91-32881

**SCATTERING COEFFICIENTS**
Aerosol sensing from balloons using photopolarimetry N91-32538

**SCHEDULES**
Collaboration technology and space science [NASA-CR-188861] N91-32846

**SCHOOLS**
Energy and technology review [DE91-016873] N91-32572

**SCINTILLATION**
Performance evaluation of new large-area avalanche photodiodes for scintillation spectroscopy [DE91-017400] N91-32405

**SCINTILLATION COUNTERS**
Performance evaluation of new large-area avalanche photodiodes for scintillation spectroscopy [DE91-017400] N91-32405
EXAM: A search for extragalactic antimatter N91-33035

**SEA ICE**
Naval arctic manual, ATP 17(A) [PB91-193920] N91-32584

**SEA SURFACE TEMPERATURE**
Climate dynamics experiments using a GCM simulations N91-32663
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688
Monitoring, analyzing, and modeling global climate N91-32689
Tropical Pacific moisture variability N91-32690

**SEA WATER**
Leaching behavior of microtektite glass compositions in sea water and the effect of precipitation on glass leaching [NASA-TM-105106] N91-32225
Chemical tracer studies at IOSDL-2: A method manual for the routine measurement of chlorofluocarbons in seawater and air [IOS-275] N91-32580

**SEALING**
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325

**SEARCHING**
Identification of essential success factors for an electronic master publication library [AD-A229624] N91-33004

**SEAS**
Sea sickness N91-32766

**SECONDARY FLOW**
Numerical treatment of laminar flow in curved rectangular channels with entrance region N91-32053
Developing laminar flow and heat transfer in orthogonally rotating square ducts N91-32054
Numerical simulation of thermal convection in a rectangular duct flow N91-32062
Numerical analysis of three-dimensional cascade flow N91-32067

**SECRETIONS**
Transport suction apparatus and absorption materials evaluation N91-32784

**SECURITY**
Interim explosives detection alternatives [DE91-016188] N91-32089
Laboratory test results of solid state video cameras [DE91-016189] N91-32399
A political scenario for Europe: Pan-European security system [FFI-91/5009] N91-33015

**SEGMENTS**
Method and apparatus for phasing segmented mirror arrays [NASA-CASE-NPO-18095-1-CU] N91-32923

**SEMICONDUCTOR DEVICES**
High performance packages for space applications N91-32311
The pre-screening of large semiconductor memories for space application N91-32357
Wideband microwave generation with GaAs photoconductive switches [DE91-017544] N91-32415
Method for anisotropic etching in the manufacture of semiconductor devices [NASA-CASE-MSC-21631-1] N91-32947

**SEMICONDUCTOR DIODES**
Development of semiconductor test structures for reliability evaluation N91-32292
Selection strategy and reliability assessment for SILEX-communication laser diodes N91-32306
Direct influence of chip design and material composition on GaAs/GaAlAs laser diodes reliability N91-32307
Assessment of p-metallisations for high power GaAs laser diodes N91-32316
Space silicon diodes: A survey of available technologies and related manufacturing and reliability aspects N91-32320

**SEMICONDUCTOR LASERS**
Selection strategy and reliability assessment for SILEX-communication laser diodes N91-32306
Direct influence of chip design and material composition on GaAs/GaAlAs laser diodes reliability N91-32307
High performance packages for space applications: Review of packaging and assembly methods for long wavelength laser diodes N91-32318
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs) [DE91-016196] N91-32407
Quantum well, beam deflecting surface emitting lasers [NASA-CASE-NPO-18243-1-CU] N91-32489

**SEMICONDUCTORS (MATERIALS)**
Planar gallium arsenide NPNP microwave switch [AD-D014948] N91-32398
Photogenerated carrier-induced reactions on semiconductor surfaces [DE91-017550] N91-32416
Monitoring interfacial dynamics by pulsed laser techniques [DE91-016950] N91-32485
Quantum well, beam deflecting surface emitting lasers [NASA-CASE-NPO-18243-1-CU] N91-32489
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium [DE91-016161] N91-32964
An overview of the electronic properties of InAs(1-x)Sb(x) strained-layer superlattices (O less than or equal to x less than or equal to 1) [DE91-017458] N91-32976
Spectroscopic properties of Nd3+ dopant ions in phosphate laser glass [DE91-017665] N91-32985

**SENSORY STIMULATION**
Physical characteristics of stimuli provoking motion sickness N91-32762

**SEPAC (PAYLOAD)**
SEPAC data analysis in support of the environmental interaction program [NASA-CR-184201] N91-32579

**SEPARATORS**
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility N91-32791

**SEPTUM**
Beam optics of the AmPS extraction line [NIKHEF-K/AMPS/91-01] N91-32914

**SEQUENCING**
Evolutionary tree reconstruction [NASA-CR-188862] N91-32816

**SERVICE LIFE**
A survey of the parasitic effects and degradation mechanisms affecting the GaAs FET-based IC's: The first step for a technological evaluation N91-32304
Advances in Li-TiS2 cell technology N91-32567

**SHAFTS (MACHINE ELEMENTS)**
Bidirectional drive and brake mechanism [NASA-CASE-MSC-21540-1] N91-32514

**SHALLOW WATER**
Parallelizing the spectral transform method, part 2 [DE91-017131] N91-32456

**SHAPED CHARGES**
Instability of shaped charged jets with general constitutive equations [FFI-91/4004] N91-32203

**SHAPES**
Report on the photogrammetric determination of the shape of a 10m diameter microwave antenna [NPL-MOM-103] N91-32248
Contour-map encoding of shape for early vision [NASA-CR-188937] N91-32545
Human analogue models for computer-aided design and engineering applications [AD-A229520] N91-32775

**SHEAR FLOW**
Turbulent flow modelling in Spain: Overview and developments N91-32448
Appraisal of the suitability of turbulence models in flow calculations: A UK view on turbulence models for turbulent shear flow calculations N91-32450
Channel flow of a concentrated suspension [DE91-016649] N91-32453

**SHEAR LAYERS**
A numerical simulation of two dimensional shear layer N91-32060
An experimental study of natural and forced modes in an axisymmetric jet
[NASA-TM-105225] N91-32074
Supersonic mixing enhancement by vorticity for high-speed propulsion
[NASA-CR-188920] N91-32079
Appraisal of the Suitability of Turbulence Models in Flow Calculations
[AGARD-AR-291] N91-32443
**SHIELDING**
Modeling of electrically thick materials theoretical and experimental aspects N91-32605
Protection of electrical and electronic equipment against lightning indirect effects on the Airbus A340 wing N91-32613
Diffuse dispersive delay and the time convolution/attenuation of transients N91-32730
**SHIPS**
Component local velocities of a ship along a defined axis
[ARE-TM(UHR)-91305] N91-32424
GEOPLOT: User guide and programmer's guide
[IOS-279] N91-32745
**SHOCK LAYERS**
An experimental study of fluctuating pressure loads beneath swept shock/boundary-layer interactions
[NASA-CR-188919] N91-32080
A laser velocimeter investigation of the normal shock-wave boundary layer interaction
[NASA-TM-105201] N91-32440
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441
**SHOCK TUBES**
Numerical simulation of shock wave emanating from a square shock tube N91-32061
**SHOCK WAVE INTERACTION**
The three dimensional Navier-Stokes simulations of flow over a wing without any turbulent modelling N91-32051
An experimental study of fluctuating pressure loads beneath swept shock/boundary-layer interactions
[NASA-CR-188919] N91-32080
**SHOCK WAVES**
Shock-vaporization studies on zinc and porous carbon
[DE91-017846] N91-32233
**SHUTTLE DERIVED VEHICLES**
Flywheel-powered shuttle car
[PB91-200543] N91-32499
**SICKNESSES**
Management of acute and chronic motion sickness N91-32769
**SIGNAL ANALYSIS**
Modeling and analysis of spacecraft battery charger systems N91-32411
**SIGNAL DETECTION**
Symbol lock detection in the ARX 2 and Block 5 receivers N91-32261
Refinement of a pulsed CO2-laser rangefinder with heterodyne detection
[FEL-90-A303] N91-32477
Weak positive cloud-to-ground flashes in Northeastern Colorado N91-32712
Integrated filter and detector array for spectral imaging
[NASA-CASE-NPO-18317-1-CU] N91-32926
**SIGNAL ENCODING**
Coding gains and error rates from the Big Viterbi Decoder N91-32264
Multi-dimensional modulation codes for fading channel
[NASA-CR-188959] N91-32288
**SIGNAL FADING**
Multi-dimensional modulation codes for fading channel
[NASA-CR-188959] N91-32288
**SIGNAL PROCESSING**
Propagation Limitations for Systems Using Band-Spreading
[AGARD-LS-172] N91-32241
Improvement in radar detection under scan-to-scan processing and scan rate reduction N91-32245
CARPET: A versatile program for radar performance analysis
[FEL-91-B002] N91-32246
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
Analysis of a multiple reception model for processing images from the solid-state imaging camera N91-32259
The Advanced Receiver II telemetry test results at Goldstone N91-32260
Design and status of the RF-digitizer integrated circuit N91-32262
Channel assignments and array gain bounds for the Ka-band array feed compensation system N91-32263
Coding gains and error rates from the Big Viterbi Decoder N91-32264
Refinement of a pulsed CO2-laser rangefinder with heterodyne detection
[FEL-90-A303] N91-32477
Airborne observations of electric fields around growing and decaying cumulus clouds N91-32616
**SIGNAL RECEPTION**
The Advanced Receiver II telemetry test results at Goldstone N91-32260
Symbol lock detection in the ARX 2 and Block 5 receivers N91-32261
**SIGNAL TO NOISE RATIOS**
The Advanced Receiver II telemetry test results at Goldstone N91-32260
Channel assignments and array gain bounds for the Ka-band array feed compensation system N91-32263
Coding gains and error rates from the Big Viterbi Decoder N91-32264
A carrier-arraying demonstration at Goldstone for receiving Pioneer 11 signals N91-32273
Carrier-to-noise power estimation for the Block 5 Receiver N91-32275
**SIGNATURES**
Global lightning studies N91-32667
**SIGNS AND SYMPTOMS**
Signs and symptoms of motion sickness and its basic nature N91-32760
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory N91-32761
Factors influencing susceptibility: Individual differences and human factors N91-32763
Prevention and treatment of motion sickness: Non-pharmacological therapy N91-32767
**SILICATES**
X ray absorption fine structure of systems in the anharmonic limit
[DE91-016070] N91-32892
**SILICON**
Space silicon diodes: A survey of available technologies and related manufacturing and reliability aspects N91-32320
Resistive gate magnetic field sensor
[AD-D014952] N91-32471
Fabrication of advanced x ray optics with magnetron mini-source arrays
[DE91-017093] N91-32919
**SILICON CARBIDES**
Tensile and cyclic fatigue properties of SiC whisker-reinforced Al2O3
[DE91-015916] N91-32179
Cryogenic cooling of x ray crystals using porous matrix
[DE91-017322] N91-32982
**SILVER**
Performance of a high T(sub c) superconducting ultra-low loss microwave stripline filter N91-32255
Tribological behavior of silver films prepared on ceramic surfaces by ion-beam-assisted deposition
[DE91-017306] N91-32505
**SIMD (COMPUTERS)**
Highly parallel computer architecture for robotic computation
[NASA-CASE-NPO-17632-1-CU] N91-32805
Highly parallel sparse Cholesky factorization
[NASA-CR-188875] N91-32847
**SIMULATION**
A global simulation of the magnetosphere with a long tail: Southward and northward IMF
[NIFS-99] N91-32592
Simulation and measurement of melting effects on metal sheets caused by direct lightning strikes N91-32644
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686
Lightning testing at the subsystem level N91-32714
A simulated lightning effects test facility for testing live and inert missiles and components N91-32725
**SIMULATORS**
Telerobot control system
[NASA-CASE-NPO-18116-1-CU] N91-32509
A transportable 50 kA dual mode lightning simulator N91-32633
A real scale simulator for high frequency LEMP N91-32700
**SINGLE CRYSTALS**
Dynamics of surface melting
[DE91-016344] N91-32206
Irradiation effects in high temperature superconductors
[DE91-016118] N91-32962
Flux pinning by planar defects in single crystal YBa2Cu3O(7-delta)
[DE91-016525] N91-32968
Magnetic relaxation in a single crystal of YBa2Cu3O(x)
[DE91-017963] N91-32986
**SINGLE EVENT UPSETS**
Radiation assessment of complex technologies N91-32342
Single event test method and test results on the Intel 80386 N91-32343
Single event upset sensitivity of a SRAM: An overview from testing procedures to device hardening (theme 2) N91-32346
Heavy-ion induced single-event upset in integrated circuits N91-32347
Single event effects by protons on low Earth orbits: A problem for European manned space missions N91-32349
The advantages of silicon-on-insulator technologies for space environments N91-32352
Measurements of proton upset induced in CMOS devices: Synthesis of CEA studies N91-32356
The pre-screening of large semiconductor memories for space application N91-32357
Radiation assessment of the INMOS transputer family N91-32358
Characterization of 256 Kbits SRAMs under californium 252 and protons irradiations N91-32359
Total dose characterization of new components for the ESA radiation effects database N91-32362
**SINTERING**
Reaction sintering of ZnO-Al2O3
[DE91-016254] N91-32210
**SIZE DISTRIBUTION**
Measurements N91-32530
Measurements in polar stratospheric clouds over Antarctica in September 1989 N91-32534
**SKIN (ANATOMY)**
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting
[DE91-017545] N91-32758
**SKIN (STRUCTURAL MEMBER)**
Modeling of electrically thick materials theoretical and experimental aspects N91-32605
FD-TD calculation with composite materials. Application to C160 aircraft measurements N91-32637
Lightning protection design and testing of an all composite wet wing for the Egrett N91-32642
**SKIN FRICTION**
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441
**SKIN RESISTANCE**
Modeling of electrically thick materials theoretical and experimental aspects N91-32605
**SKY SURVEYS (ASTRONOMY)**
Design of the Digital Sky Survey DA and online system: A case history in the use of computer aided tools for data acquisition system design
[DE91-016469] N91-33032
**SKYDROL (TRADEMARK)**
Resistance of perished paints to Skydrol
[INFORME-I-536/90] N91-32223
**SLENDER CONES**
An approximate Riemann solver for hypervelocity flows
[NASA-CR-187629] N91-32463
**SLIP FLOW**
Solution of perfect gas viscous flows via compressible Navier-Stokes equations with wallslip conditions
[ONERA-RSF-13/3637-AY] N91-32435
**SMALL PERTURBATION FLOW**
A numerical simulation of two dimensional shear layer N91-32060
**SMALL SCIENTIFIC SATELLITES**
Small capacity, low cost (Ni-H2) design concept for commercial, military, and higher-volume aerospace applications N91-32565
**SMOKE**
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539
**SNOWSTORMS**
On charging of snow particles in blizzard N91-32724
**SODIUM CHLORIDES**
Equations of state for solid NaCl-KCl and liquid NaCl-KCl-H2O
[DE91-016980] N91-32195
**SODIUM COMPOUNDS**
Sodium-metal chloride battery research at JPL N91-32566
**SOFIA (AIRBORNE OBSERVATORY)**
SOFIA: A Stratospheric Observatory for Infrared Astronomy
[NASA-TM-103840] N91-33033
**SOFTWARE ENGINEERING**
Advanced visualization techniques N91-32669
ESA software engineering standards, issue 2
[ESA-PSS-05-0-ISSUE-2] N91-32811

Beyond formalism
[NASA-CR-188886] N91-32819
ART-Ada: An Ada-based expert system tool
[NASA-CR-188930] N91-32837
The use of software metrics to evaluate information systems N91-33003
Design of the Digital Sky Survey DA and online system: A case history in the use of computer aided tools for data acquisition system design
[DE91-016469] N91-33032

**SOFTWARE TOOLS**
Aerodynamic computation post processing tools
[AAAF-NT-89-20] N91-32073
Automated IDEF3 and IDEF4 systems design specification document
[NASA-CR-188830] N91-32803
SPARSKIT: A basic tool kit for sparse matrix computations
[NASA-CR-185876] N91-32865

**SOI (SEMICONDUCTORS)**
The advantages of silicon-on-insulator technologies for space environments N91-32352

**SOIL MOISTURE**
Climate dynamics experiments using a GCM simulations N91-32663
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687

**SOLAR ACTIVITY**
Solar-geophysical data number 560, April 1991. Part 1: (Prompt reports). Data for March, February 1991, and late data
[PB91-193508] N91-33047
Solar particle events during the rising phase of solar cycle 22
[DE91-016042] N91-33049

**SOLAR CELLS**
GaAs/Ge solar cell for space applications N91-32293
Solar radiation on Mars: Update 1991
[NASA-TM-105216] N91-33046

**SOLAR COLLECTORS**
Space qualification test and evaluation of JHU/APL designed ASICs N91-32315

**SOLAR ENERGY CONVERSION**
SERI Solar Radiation Resource Assessment Project
[DE91-002164] N91-32575
Solar radiation on Mars: Update 1991
[NASA-TM-105216] N91-33046

**SOLAR GENERATORS**
Solar radiation on Mars: Update 1991
[NASA-TM-105216] N91-33046

**SOLAR MAGNETIC FIELD**
Solar-geophysical data number 560, April 1991. Part 1: (Prompt reports). Data for March, February 1991, and late data
[PB91-193508] N91-33047

**SOLAR PHYSICS**
Solar astronomy N91-33026
Solar-geophysical data number 560, April 1991. Part 1: (Prompt reports). Data for March, February 1991, and late data
[PB91-193508] N91-33047
Solar-geophysical data number 560, April 1991. Part 2: (Comprehensive reports). Data for October 1990 and miscellaneous
[PB91-193516] N91-33048

**SOLAR PROMINENCES**
Solar-geophysical data number 560, April 1991. Part 2: (Comprehensive reports). Data for October 1990 and miscellaneous
[PB91-193516] N91-33048

**SOLAR PROTONS**
Solar particle events during the rising phase of solar cycle 22
[DE91-016042] N91-33049

**SOLAR RADIATION**
SERI Solar Radiation Resource Assessment Project
[DE91-002164] N91-32575
Solar radiation on Mars: Update 1991
[NASA-TM-105216] N91-33046

**SOLAR SYSTEM**
Scouting the neighborhood: In our lifetime
[DE91-017083] N91-32151

**SOLAR SYSTEM EVOLUTION**
Rosetta/CNSR: A comet-nucleus sample-return mission and system definition document
[ESA-SP-1125] N91-32152

**SOLDERED JOINTS**
Fundamental metallurgical considerations in brazing and soldering
[DE91-016224] N91-32209

**SOLDERING**
Fundamental metallurgical considerations in brazing and soldering
[DE91-016224] N91-32209

**SOLID ELECTROLYTES**
Some recent studies with the solid-ionomer electrochemical capacitor N91-32562
Modeling water content effects in polymer electrolyte fuel cells
[DE91-016027] N91-32573

**SOLID PHASES**
User's manual for PANDA 2: A computer code for calculating equations of state
[DE91-017717] N91-32843

**SOLID SOLUTIONS**
Equations of state for solid NaCl-KCl and liquid NaCl-KCl-H2O
[DE91-016980] N91-32195

**SOLID STATE**
Laboratory test results of solid state video cameras
[DE91-016189] N91-32399
Current status of solid-state lithium batteries employing solid redox polymerization cathodes
[DE91-016988] N91-32404

**SOLID STATE DEVICES**
Non volatile solid state magnetic memory technologies N91-32294
A solid state mass memory for space applications: Technological and system aspects N91-32329
Development and operation of a solid-state switch for thyratron replacement
[DE91-016553] N91-32401

**SOLID STATE LASERS**
A power beaming based infrastructure for space power
[DE91-017533] N91-32169
Laser performance and optical properties of LiSrGaF6:Cr(3+)
[DE91-016555] N91-32481

**SOLID-SOLID INTERFACES**
GaAs/Ge solar cell for space applications N91-32293

**SOLIDS**
Liquid and solid Ga and Bi studies with a variable energy positron beam
[DE91-016910] N91-32889

**SOLIDS FLOW**
Study of flow properties of wet solids using laser induced photo chemical anemometry
[DE91-016877] N91-32454

**SOLVATION**
Multiheteromacrocycles that complex metal ions
[DE91-016292] N91-32205

**SONAR**
Maximum likelihood estimation applied to target motion analysis using second order derivatives
[FEL-89-A193] N91-32862

**SOOT**
International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects
[NASA-CP-3114] N91-32528
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539

**SOS (SEMICONDUCTORS)**
An 8 bit high performance ADC in silicon on sapphire N91-32302
Analog CMOS/SOS in radiative environments N91-32350
Simulation of radiation induced circuit failure modes in SOS integrated circuits N91-32351
SOS material improvement for post total dose, radiation induced leakage reduction N91-32353

**SOUND PROPAGATION**
Near ground sound propagation in wind
[CSTB-2-89-003-4] N91-32871

**SOUND WAVES**
Near ground sound propagation in wind
[CSTB-2-89-003-4] N91-32871

**SPACE ADAPTATION SYNDROME**
Motion Sickness: Significance in Aerospace Operations and Prophylaxis
[AGARD-LS-175] N91-32759
Factors influencing susceptibility: Individual differences and human factors N91-32763
Space sickness N91-32764

**SPACE CHARGE**
A new approach to the determination of the striking distance from the lightning channel photos N91-32698
On error sources during airborne measurements of the ambient electric field N91-32719
Optimal parameters of leader development in lightning N91-32723

**SPACE COMMERCIALIZATION**
Design and manufacture of space ASICs today and tomorrow: Promises and problems N91-32299

**SPACE COMMUNICATION**
Data compression for full motion video transmission
[NASA-TM-105239] N91-32247
The Telecommunications and Data Acquisition Report
[NASA-CR-188813] N91-32250
Efficiency calibration of the DSS 13 34-meter diameter beam waveguide antenna at 8.45 and 32 GHz N91-32271

**SPACE ENVIRONMENT SIMULATION**
Mating and unmating of multi-pin connectors under vacuum N91-32319
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325
Calibration of ASIC library for radiation tolerant space applications methodology and experiment N91-32334
Space radiation effects on CCDs N91-32339

**SPACE EXPLORATION**
Scouting the neighborhood: In our lifetime
[DE91-017083] N91-32151
The NASA cryogenic fluid management technology program plan
[NASA-TM-105256] N91-32161
Millimeter wavelength communications applications for the SEI
[NASA-TM-105275] N91-32287
Policy opportunities N91-33029

**SPACE MECHANICS**
A new variational formulation of kinetic plasma theory and the application of moving finite elements
[DE91-016072] N91-32938

**SPACE MISSIONS**
The Advanced Receiver II telemetry test results at Goldstone N91-32260
Modeling preparation costs for space missions by using major cost drivers N91-32279

**SPACE NAVIGATION**
Millimeter wavelength communications applications for the SEI
[NASA-TM-105275] N91-32287

**SPACE OBSERVATIONS (FROM EARTH)**
Observations of Enhanced Radar Backscatter (ERB) from Millstone Hill
[NASA-CR-188877] N91-32280

**SPACE PLATFORMS**
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686

**SPACE POWER REACTORS**
Power system requirements and selection for the space exploration initiative
[DE91-016707] N91-32150
Performance enhancement using power beaming for electric propulsion Earth orbital transporters
[DE91-017287] N91-32168
Neutron, gamma ray and post-irradiation thermal annealing effects on power semiconductor switches
[NASA-TM-105248] N91-32410
Status of NASA's Stirling Space Power Converter Program
[NASA-TM-104512] N91-32569

**SPACE PROGRAMS**
Federal radionavigation plan, 1990
[PB91-190868] N91-32091
Upscreening of components for space applications N91-32376
Cost effective electronic components for short life space missions N91-32387
Interferometry N91-33022

**SPACE RENDEZVOUS**
Optimal cooperative time-fixed impulsive rendezvous N91-32153

**SPACE SHUTTLE BOOSTERS**
Lightning protection for shuttle propulsion elements N91-32630

**SPACE SHUTTLE MAIN ENGINE**
Lightning protection for shuttle propulsion elements N91-32630

**SPACE SHUTTLE ORBITERS**
Shuttle Orbiter medical system equipment/supplies evaluation N91-32793

**SPACE SHUTTLE PAYLOADS**
Lightning to the upper atmosphere: A vertical light pulse from the top of a thunderstorm as seen by a payload bay TV camera of the space shuttle N91-32720

**SPACE SHUTTLES**
Lightning current rate of rise in the new lightning flash model for the space shuttle program N91-32604

**SPACE STATION FREEDOM**
Medical evaluations on the KC-135 1990 flight report summary
[NASA-TM-104740] N91-32776
Health maintenance facility: Dental equipment requirements N91-32777
Dental equipment test during zero-gravity flight N91-32778
Mini-rack testbed evaluation N91-32779
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
Ada issues in implementing ART-Ada
[NASA-CR-188941] N91-32838

Toward the efficient implementation of expert systems in Ada
[NASA-CR-188942] N91-32839
Coping with data from Space Station Freedom
[NASA-CR-188885] N91-33005

**SPACE STATION POWER SUPPLIES**
GaAs/Ge solar cell for space applications N91-32293

**SPACE STATIONS**
Initial pointing calibrations for the DSS 13 34-meter beam-waveguide antenna N91-32267
Modeling and simulations of the DSS 13 antenna control system N91-32268
A carrier-arraying demonstration at Goldstone for receiving Pioneer 11 signals N91-32273

**SPACE TRANSPORTATION**
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034
Performance enhancement using power beaming for electric propulsion Earth orbital transporters
[DE91-017287] N91-32168
A power beaming based infrastructure for space power
[DE91-017533] N91-32169

**SPACEBORNE ASTRONOMY**
UV-optical from space N91-33021
High energy from space N91-33023

**SPACEBORNE EXPERIMENTS**
Lightning to the upper atmosphere: A vertical light pulse from the top of a thunderstorm as seen by a payload bay TV camera of the space shuttle N91-32720

**SPACEBORNE TELESCOPES**
UV-optical from space N91-33021

**SPACECRAFT CHARGING**
SEPAC data analysis in support of the environmental interaction program
[NASA-CR-184201] N91-32579

**SPACECRAFT COMMUNICATION**
Frame error rate of the NASA concatenated coding system N91-32266
Coping with data from Space Station Freedom
[NASA-CR-188885] N91-33005

**SPACECRAFT COMPONENTS**
Composite-faced sandwich construction for primary spacecraft structures N91-32170
ESA's component programme plan N91-32373
Upscreening of components for space applications N91-32376
Space flight components database N91-32377
CPFS: The total information system tool for EEE-parts procurement N91-32379
A plan of NASDA's parts database in the reliability information system N91-32381
The crimping of high-reliability electrical connections
[ESA-PSS-01-726-ISSUE-2] N91-32421

**SPACECRAFT CONSTRUCTION MATERIALS**
Materials compatibility issues for fabric composite radiators
[DE91-017556] N91-32186
New technologies for integrating thermal control, and radiation protection in hybrid technology N91-32330
Hanover University research report
[ISSN-0723-1903] N91-33052

**SPACECRAFT ELECTRONIC EQUIPMENT**
Design, development, and qualification of special super N-channel MOSFET die for space applications N91-32297
CNES activities on ASIC N91-32298
Design and manufacture of space ASICs today and tomorrow: Promises and problems N91-32299
Digital ASIC design for space applications N91-32300
Reliability of microwave bipolar silicon transistors N91-32305
Surface mount on ceramic: How to achieve a space quality level N91-32309
The role of photosensitive polyimides in the development of hybrid space hardware N91-32321
Space radiation effects on CCDs N91-32339
Further proton damage effects in EEV CCDs N91-32340
Total dose effects on Charge Coupled Devices (CCD) reverse annealing phenomena N91-32341
Radiation assessment of complex technologies N91-32342
Single event test method and test results on the Intel 80386 N91-32343
Radiation sensitivity of power MOSFETS N91-32344
Trends in latch-up sensitivity N91-32345
Single event upset sensitivity of a SRAM: An overview from testing procedures to device hardening (theme 2) N91-32346
Heavy-ion induced single-event upset in integrated circuits N91-32347
CECIL: Collaboration between companies and research agencies in heavy ion test of spacecraft microelectronics N91-32348
The advantages of silicon-on-insulator technologies for space environments N91-32352
Irradiation tests and radiation hardness prediction considerations on electronic components for space application N91-32355
Space radiation effects on power MOSFET: Threshold-voltage shift with dose rate N91-32363
Results and considerations on failure investigations of components used for space equipment N91-32365
Experiences with components in the DFS-project: Seen from a customer's point of view N91-32366
Summary of EEE component anomalies encountered in the SPOT line of Earth observation satellites and lessons derived therefrom for future generations N91-32367
A statistical evaluation of EEE-parts procurement data from telecommunication satellites N91-32368
An overview of the NASA electronic components information management system N91-32369
The history of space quality EEE parts in the United States N91-32370
Rationales for the selection of a parts procurement system (coordinated versus centralized) from a prime contractor point of view N91-32371
EEC component procurement: A look ahead N91-32372
ESA's component programme plan N91-32373
NASA's challenge for tomorrow N91-32374
Parts management for the 1990's N91-32375
Preparing electronics quality for the next century N91-32382
Space manufacturing quality through statistical process control: An application at Texas Instruments France, a space semiconductors production line N91-32384
Total quality management: What are the facts behind the concepts? N91-32385
Which position for MIL-space industry facing QML concept N91-32386
Cost effective electronic components for short life space missions N91-32387
ABB Hafo's ESA approved capability domain for CMOS/SOS ASICs N91-32388
Evaluation of advanced microelectronics for inclusion in MIL-STD-975 N91-32390
A comparison of the specifications for standard Electrical, Electronic and Electromechanical (EEE) parts used by the National Aeronautics and Space Admininstration (NASA) and the European Space Agency (ESA): Towards common specifications N91-32391
Specification, procurement and testing of passivated microwave semiconductor chips for space applications N91-32393

**SPACECRAFT ENVIRONMENTS**
New technologies for integrating thermal control, and radiation protection in hybrid technology N91-32330

**SPACECRAFT EQUIPMENT**
Two fault tolerant toggle-hook release
[NASA-CASE-MSC-21671-1] N91-32498

**SPACECRAFT INSTRUMENTS**
Fiber-optic applications for space-based engines
[NASA-TM-105235] N91-32163
New technologies for integrating thermal control, and radiation protection in hybrid technology N91-32330

**SPACECRAFT MANEUVERS**
Optimal cooperative time-fixed impulsive rendezvous N91-32153

**SPACECRAFT MODELS**
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525
Lightning current rate of rise in the new lightning flash model for the space shuttle program N91-32604

**SPACECRAFT POWER SUPPLIES**
Power system requirements and selection for the space exploration initiative
[DE91-016707] N91-32150
Performance enhancement using power beaming for electric propulsion Earth orbital transporters
[DE91-017287] N91-32168
A power beaming based infrastructure for space power
[DE91-017533] N91-32169
Spacecraft power system concerns regarding failure modes within complex integrated circuits and hybrid packages N91-32308
Modeling and analysis of spacecraft battery charger systems N91-32411
Small capacity, low cost (Ni-H2) design concept for commercial, military, and higher-volume aerospace applications N91-32565

**SPACECRAFT PROPULSION**
MPD thruster technology
[NASA-TM-105242] N91-32162
Multimegawatt electric propulsion system design considerations
[NASA-TM-105152] N91-32164
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components
[NASA-CR-187196] N91-32524

**SPACECRAFT RADIATORS**
Materials compatibility issues for fabric composite radiators
[DE91-017556] N91-32186

**SPACECRAFT STRUCTURES**
Composite-faced sandwich construction for primary spacecraft structures N91-32170

**SPARK GAPS**
Diffuse dispersive delay and the time convolution/attenuation of transients N91-32730

**SPARK IGNITION**
Braun heat pump engine/compressor and its hermetic rod seal
[DE91-017151] N91-32239

**SPARKS**
Correlation between some current parameters and optical radiation generated by 280 mm long laboratory sparks N91-32655
Measurements of some parameters of thermal sparks with respect to their ability to ignite aviation fuel/air mixtures N91-32705

**SPATIAL DISTRIBUTION**
Potential vorticity index N91-32672
The spatial variations of lightning during small Florida thunderstorms N91-32711

**SPATIAL RESOLUTION**
Laboratory test results of solid state video cameras
[DE91-016189] N91-32399

**SPECIFIC IMPULSE**
A nuclear thermal rocket engine design based on the particle bed reactor suitable for a Mars mission
[DE91-016898] N91-32160

**SPECIFICATIONS**
Guidelines for carbon and other advanced fibre prepreg procurement specifications
[ESA-PSS-03-207-ISSUE-1] N91-32176
The crimping of high-reliability electrical connections
[ESA-PSS-01-726-ISSUE-2] N91-32421
Beyond formalism
[NASA-CR-188886] N91-32819

**SPECKLE INTERFEROMETRY**
Indirect imaging through the atmosphere
[ESA-TT-1115] N91-33034

**SPECTRA**
Temporal and spectral features of wall pressure fluctuations beneath a turbulent boundary layer N91-32461
Inconsistencies with the single impurity Undersign model in photoelectron spectra of cerium heavy fermion compounds
[DE91-016239] N91-32878

**SPECTRAL METHODS**
Spectral element methods for the unsteady Navier-Stokes equations N91-32432
Parallelizing the spectral transform method, part 2
[DE91-017131] N91-32456

**SPECTROSCOPIC ANALYSIS**
Spectroscopic wear detector
[NASA-CASE-LEW-15200-1] N91-32167
Atmospheres of comets: Gas dynamic models and inference of kinematic parameters N91-33036

**SPECTROSCOPY**
The application of time-resolved luminescence spectroscopy to a remote uranyl sensor
[DE91-016310] N91-32189
Performance evaluation of new large-area avalanche photodiodes for scintillation spectroscopy
[DE91-017400] N91-32405
High pressure Moessbauer spectroscopy in diamond anvil cells
[DE91-016018] N91-32961
Ion implantation effects in crystalline quartz
[DE91-016192] N91-32977
Optical diagnostics of mercuric iodide crystal growth
[DE91-017396] N91-32983
Spectroscopic properties of Nd3+ dopant ions in phosphate laser glass
[DE91-017665] N91-32985

**SPECTRUM ANALYSIS**
Advanced fusion diagnostics
[DE91-017412] N91-32941
Alleviation of interferences and reduction of sample memory in inductively coupled plasma mass spectrometry
[DE91-016399] N91-32943
Solar-geophysical data number 560, April 1991. Part 1: (Prompt reports). Data for March, February 1991, and late data
[PB91-193508] N91-33047

**SPENT FUELS**
Gamma ray collimator
[NASA-CASE-SSC-00013-1] N91-32515
Further development of IDGS: Isotope dilution gamma-ray spectrometry
[DE91-016315] N91-32936
**SPHEROIDS**
An iterative method for obtaining the optimum lightning location on a spherical surface N91-32709
**SPINE**
Application and use of spinal immobilization devices in zero-gravity flight N91-32781
**SPLINES**
G/SPLINES: A hybrid of Friedman's Multivariate Adaptive Regression Splines (MARS) algorithm with Holland's genetic algorithm
[NASA-CR-188935] N91-32836
Spline methods for conservation equations
[DE91-017152] N91-32867
**SPLITTING**
Upwind methods and multidimensional splittings for the Euler equations N91-32429
Fluctuation splitting schemes for the 2D Euler equations N91-32430
**SPONTANEOUS EMISSION**
Spontaneous emission from free electron lasers
[DE91-017820] N91-32491
**SPORES**
Photobiological investigations on spores of Streptomyces griseus
[DLR-FB-91-14] N91-32748
**SPOT (FRENCH SATELLITE)**
Summary of EEE component anomalies encountered in the SPOT line of Earth observation satellites and lessons derived therefrom for future generations N91-32367
Automatic land-use classification using LANDSAT-5 thematic mapper data in a region of the Itzehoer Geest. An attempt to improve mapping by combination with panchromatic SPOT data
[DLR-FB-90-47] N91-32542
**SPOT WELDS**
Effect of thermal exposure, forming, and welding on high-temperature, dispersion-strengthened aluminum alloy: Al-8Fe-1V-2Si
[NASA-CR-187575] N91-32200
**SPRAYERS**
Development of a spray-forming process for steel
[DE91-015812] N91-32218
Evaluation of aerosolized medications during parabolic flight maneuvers N91-32783
**SPREAD SPECTRUM TRANSMISSION**
Propagation Limitations for Systems Using Band-Spreading
[AGARD-LS-172] N91-32241
Wide band systems N91-32242
**SPUTTERING**
Ion beam sputtering in electric propulsion facilities
[NASA-TM-105145] N91-32158
Lubrication with sputtered MoS2 films: Principles, operation, limitations
[NASA-TM-105292] N91-32216
**STABILITY**
Instability of shaped charged jets with general constitutive equations
[FFI-91/4004] N91-32203
**STABILIZATION**
Catalytic combustion of methane
[PB91-206391] N91-32190
**STABILIZERS (FLUID DYNAMICS)**
The electromagnetic environment in CFC structures N91-32638
**STAINLESS STEELS**
Photon stimulated desorption from aluminum and stainless steel
[DE91-017007] N91-32211
Irradiation-induced chromium depletion and its influence on integranular stress corrosion cracking of stainless steels
[DE91-017418] N91-32212
Numerical simulation of a laser welding process
[DE91-016454] N91-32500
Measurements of induced radioactivity in some LDEF samples
[DE91-016309] N91-32882
**STANDARDIZATION**
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
US TAG for ISO/TC108 mechanical vibration and shock: Minutes of the accredited standards committee on mechanical shock and vibration, S2
[AD-A239536] N91-32521
Quality assurance of field screening
[DE91-016303] N91-32582
Approved Ada uniformity issues
[NPL-DITC-172/91] N91-32809
The language compatible arithmetic standard and Ada
[NPL-DITC-173/91] N91-32810
Environment, Safety and Health Thesaurus/Dictionary
[DE91-013428] N91-33012
**STANDARDS**
Comparison of factors given in ICRU report 23 and IAEA TRS 277 for converting from exposure/air kerma to absorbed dose to water for medium energy x rays
[NPL-RSA(EXT)-15] N91-32147
Standards for polymer matrix composites. Part 2: Assessment and comparison of CRAG test methods
[NPL-DMM(A)-7-PT-2] N91-32174
Design and manufacture of space ASICs today and tomorrow: Promises and problems N91-32299
Irradiation tests and radiation hardness prediction considerations on electronic components for space application N91-32355
EQML: A chance for Europe N91-32383
A comparison of the specifications for standard Electrical, Electronic and Electromechanical (EEE) parts used by the National Aeronautics and Space Admininstration (NASA) and the European Space Agency (ESA): Towards common specifications N91-32391
Is the ESA/SCC screening technique more efficient than the MIL specifications? N91-32392
The United Kingdom waveguide power standards above 40 GHz
[NPL-DES-105] N91-32395
The repair and modification of printed-circuit board assemblies for space use
[ESA-PSS-01-728-ISSUE-2] N91-32422
ESA software engineering standards, issue 2
[ESA-PSS-05-0-ISSUE-2] N91-32811
Intercomparison of standards of absorbed dose between the USSR and the UK
[NPL-RSA(EXT)-17] N91-32874
**STARK EFFECT**
Advanced fusion diagnostics
[DE91-017412] N91-32941
**STATIC DISCHARGERS**
Results of the recent precipitation static flight test program on the Navy P-3B antisubmarine aircraft N91-32626
**STATIC ELECTRICITY**
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1
[NASA-CP-3106-VOL-1] N91-32599
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 2
[NASA-CP-3106-VOL-2] N91-32693
**STATIC LOADS**
Delaminations in composite plates under transverse static or impact loads N91-32183
**STATIC PRESSURE**
Unsteady flowfield of a propfan at takeoff conditions
[NASA-TM-105223] N91-32075
**STATIC STABILITY**
Control design variable linking for optimization of structural/control systems N91-32144
**STATIC TESTS**
Results of the recent precipitation static flight test program on the Navy P-3B antisubmarine aircraft N91-32626
**STATISTICAL ANALYSIS**
Carrier-to-noise power estimation for the Block 5 Receiver N91-32275
Wideband HF noise/interference modeling, part 1. First-order statistics. Technical memorandum series
[PB91-208454] N91-32281
A statistical evaluation of EEE-parts procurement data from telecommunication satellites N91-32368
Space manufacturing quality through statistical process control: An application at Texas Instruments France, a space semiconductors production line N91-32384
Mexico City air quality research initiative: An overview and some statistical aspects
[DE91-018045] N91-32590
Characteristics of winter lightning currents struck an isolated tower N91-32607
Saving all the bits
[NASA-CR-188879] N91-32817
**STATISTICAL CORRELATION**
Mode-stirred chamber field statistics: Correlation widths
[DE91-016190] N91-32285
**STATORS**
Navier-Stokes computations of three-dimensional turbine cascade flows N91-32068
**STEADY FLOW**
Parabolized Navier-Stokes methods for ducted flow systems N91-32434
Appraisal of the Suitability of Turbulence Models in Flow Calculations
[AGARD-AR-291] N91-32443
Computational turbulence studies in Turkey N91-32449
**STEADY STATE**
Stochastic availability analysis of operational data systems in the Deep Space Network N91-32278
**STEELS**
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application
[NASA-TM-103551] N91-32217
High speed welding used in building metallic structures
[CRIF-MT-180] N91-32496
Damage to metallic samples produced by measured lightning currents N91-32640
**STELLAR EVOLUTION**
Coalescing binary systems of compact objects to (post) sup 5/2 Newtonian order: Late-time evolution and gravitational radiation emission N91-33037
Astrophysical neutron capture processes
[DE91-017071] N91-33039
**STELLAR LUMINOSITY**
Coalescing binary systems of compact objects to (post) sup 5/2 Newtonian order: Late-time evolution and gravitational radiation emission N91-33037
**STELLAR MASS EJECTION**
Solar-geophysical data number 560, April 1991. Part 2: (Comprehensive reports). Data for October 1990 and miscellaneous
[PB91-193516] N91-33048
**STELLAR PHYSICS**
Particle astrophysics N91-33024
**STELLARATORS**
An H-mode-like bifurcation in core plasma of stellarators
[NIFS-97] N91-32933
Development of the stellarator/heliotron research
[NIFS-84] N91-32957
**STEREOPHOTOGRAPHY**
Model calculations for a pushbroom stereo camera: The case of the Mars 94 High Resolution Stereo Camera (HRSC)
[DLR-FB-90-57] N91-32468
**STIFFNESS MATRIX**
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components
[NASA-CR-187196] N91-32524
**STIMULATION**
Lightning testing at the subsystem level N91-32714
**STIRLING CYCLE**
Status of NASA's Stirling Space Power Converter Program
[NASA-TM-104512] N91-32569
**STOCHASTIC PROCESSES**
Stochastic availability analysis of operational data systems in the Deep Space Network N91-32278
Electron distribution functions in electric field environments N91-32726
Performance of a benchmark implementation of the Van Slyke and Wets algorithm for stochastic programs on the Alliant FX/8
[DE91-016515] N91-32833
Self-generated stochastic heating in an RF discharge
[DE91-017404] N91-32948
Bifurcations and patterns in non-linear dissipative systems
[DE91-017402] N91-32984
**STOKES LAW (FLUID MECHANICS)**
Numerical study of Stokes flows with suspended particles
[DE91-017011] N91-32455
**STORAGE RINGS (PARTICLE ACCELERATORS)**
A pulsed lepton source at LAMPF
[DE91-016010] N91-32904
Ion clearing and photoelectron production in the 200 MeV SXLS ring
[DE91-017156] N91-32907
**STORAGE TANKS**
Lightning protection for shuttle propulsion elements N91-32630
The essential linearity of thermal radiation net transport
[DE91-016734] N91-32990
**STORMS (METEOROLOGY)**
VHF discharges in storm cells producing microbursts N91-32620
**STOVL AIRCRAFT**
Prediction techniques for jet-induced effects in hover on STOVL aircraft
[NASA-TM-102818] N91-32070
Application of an integrated flight/propulsion control design methodology to a STOVL aircraft
[NASA-TM-105254] N91-32143
**STOWAGE (ONBOARD EQUIPMENT)**
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals N91-32785

**STRAIN DISTRIBUTION**
Interlaminar deformations on the cylindrical surface of a hole in laminated composites: An experimental study N91-32172
**STRAIN ENERGY RELEASE RATE**
Failure mechanisms and prediction in advanced composite materials N91-32184
**STRAIN RATE**
Instability of shaped charged jets with general constitutive equations
[FFI-91/4004] N91-32203
**STRANGE ATTRACTORS**
Research highlights: June 1990 - May 1991 N91-32676
**STRATEGY**
Europe 1993: Challenge and opportunity for distribution logistics N91-32998
**STRATIFICATION**
Fluid dynamics of double diffusive systems
[DE91-017401] N91-32465
**STRATOCUMULUS CLOUDS**
Nonlinear feedbacks between stratocumulus and synoptic-scale systems N91-32674
**STRATOSPHERE**
International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects
[NASA-CP-3114] N91-32528
Science issues N91-32529
Measurements N91-32530
Annular denuders for use in global climate and stratospheric measurements of acidic gases and particles N91-32531
Annular denuder systems: Precision and applicability to stratospheric sampling N91-32532
Laboratory and field studies of stratospheric aerosols: Phase changes under high supersaturation N91-32533
Measurements in polar stratospheric clouds over Antarctica in September 1989 N91-32534
Validation of lidar and satellite remote sensing N91-32535
Lidar measurements at Garmisch, conversion model, and midlatitude aerosol effects N91-32536
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537
Aerosol sensing from balloons using photopolarimetry N91-32538
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539
A lidar equipped with photon counter for measuring stratospheric aerosols N91-32540
In situ measurements of light extinction of stratospheric aerosols N91-32541
Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere N91-32673
Global temperature variations N91-32683
Lightning to the upper atmosphere: A vertical light pulse from the top of a thunderstorm as seen by a payload bay TV camera of the space shuttle N91-32720
**STREAK CAMERAS**
Measurement of modulation transfer function for four types of imaging elements used in fast cameras
[DE91-017399] N91-32475
Applications of synchroscan and dual-sweep streak camera techniques to free-electron laser experiments
[DE91-016017] N91-32479
**STREPTOMYCETES**
Photobiological investigations on spores of Streptomyces griseus
[DLR-FB-91-14] N91-32748
**STRESS ANALYSIS**
Shock-vaporization studies on zinc and porous carbon
[DE91-017846] N91-32233
Results and considerations on failure investigations of components used for space equipment N91-32365
Stress states in wound capacitors
[DE91-016402] N91-32400
Some current approaches in turbulence modelling N91-32446
Uncertainties in stress analysis on marine structures
[PB91-193441] N91-32522
Simplified micromechanical equations for thermal residual stress analysis of coated fiber composites
[NASA-CR-187599] N91-32527
Ion implantation effects in crystalline quartz
[DE91-016192] N91-32977
**STRESS CORROSION CRACKING**
Irradiation-induced chromium depletion and its influence on integranular stress corrosion cracking of stainless steels
[DE91-017418] N91-32212
The role of anodic dissolution in the stress corrosion cracking of Al-Li-Cu alloy 2090
[DE91-016403] N91-32219
**STRESS DISTRIBUTION**
A study of fracture mechanisms in ATD roller bearing
[NASA-CR-184200] N91-32497
**STRESS-STRAIN RELATIONSHIPS**
Microstructural change and its influence on stress-strain behavior of two superplastic materials
[DE91-017431] N91-32980
**STRESSES**
Ion implantation effects in crystalline quartz
[DE91-016192] N91-32977
**STRING THEORY**
Effective theories and thresholds in particle physics
[DE91-016257] N91-32880
A dynamical picture of hadron-hadron collisions with the string-parton model
[DE91-016278] N91-32881
**STRIP TRANSMISSION LINES**
Low-cost 3 kV, triggered, stripline, surface-discharge switch
[DE91-016641] N91-32403
**STRUCTURAL ANALYSIS**
Control design variable linking for optimization of structural/control systems N91-32144
Algorithms for structural natural-frequency design N91-32252
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components
[NASA-CR-187196] N91-32524
**STRUCTURAL DESIGN**
Algorithms for structural natural-frequency design N91-32252
Finite element implementation of state variable-based viscoplasticity models
[NASA-CR-187212] N91-32523
**STRUCTURAL VIBRATION**
Integrated mechanics for the passive damping of polymer-matrix composites and composite structures
[NASA-TM-104346] N91-32181
**STUDENTS**
Energy and technology review
[DE91-016873] N91-32572
**SUBROUTINES**
GEOPLOT: User guide and programmer's guide
[IOS-279] N91-32745
**SUBSONIC FLOW**
Parabolized Navier-Stokes methods for ducted flow systems N91-32434
**SUBSONIC SPEED**
An example of requirements for Advanced Subsonic Civil Transport (ASCT) flight control system using structured techniques
[NASA-CR-187526] N91-32132
**SUBSTRATES**
Ceramic coatings on smooth surfaces
[NASA-CASE-LEW-15164-2] N91-32229
Resistive gate magnetic field sensor
[AD-D014952] N91-32471
**SUCTION**
Health maintenance facility: Dental equipment requirements N91-32777
Dental equipment test during zero-gravity flight N91-32778
Transport suction apparatus and absorption materials evaluation N91-32784
Fluid handling 2: Surgical applications N91-32790
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility N91-32791
**SULFATES**
Laser heated calcium sulfate TLD plates: Application to radiation mapping N91-32364
Science issues N91-32529
**SULFUR FLUORIDES**
Evidence for SF4 and SF2 formation in SF6 corona discharges
[DE91-015927] N91-32285
**SUM RULES**
A new approximate sum rule for bulk alloy properties
[NASA-TM-105282] N91-32204
**SUMMER**
A guidebook for the control of summer heat islands
[DE91-016246] N91-32586
**SUNLIGHT**
Historical sunshine and cloud data in the United States
[DE91-016825] N91-32741
**SUPERCOMPUTERS**
Saving all the bits
[NASA-CR-188879] N91-32817
Mutual exclusion
[NASA-CR-188122] N91-32822
Present and future supercomputer network architectures
[DE91-018035] N91-32855
What's happening with supercomputer networks?
[DE91-018036] N91-32856
**SUPERCONDUCTING FILMS**
Evidence for cation disorder in in-situ grown YBaCuO superconducting films
[DE91-016760] N91-32971
Critical currents in sputtered YBCO films
[DE91-017976] N91-32987
**SUPERCONDUCTING MAGNETS**
Computation applied to particle accelerator simulations
[DE91-017128] N91-32906
**SUPERCONDUCTING SUPER COLLIDER**
Computation applied to particle accelerator simulations
[DE91-017128] N91-32906
**SUPERCONDUCTIVITY**
Performance of a high T(sub c) superconducting ultra-low loss microwave stripline filter N91-32255
High temperature superconductivity: The early 1991 edition
[DE91-017655] N91-32417
Ion clearing and photoelectron production in the 200 MeV SXLS ring
[DE91-017156] N91-32907
Oxygen ordered superstructures and domain formation in YBa2Cu3O(7-x)
[DE90-015633] N91-32958
Ion beams in high-temperature superconductivity research
[DE91-016521] N91-32965
Scaling behavior of the fluctuations in magnetization and conductivity of untwinned YBa2Cu3O(7-delta)
[DE91-016524] N91-32967
Magnetic relaxation of the organic superconductor kappa-(BEDT-TTF)2Cu(N(CN)2)Br
[DE91-016528] N91-32969
Analogous behavior in the quantum hall effect, anyon superconductivity, and the standard model
[DE91-016609] N91-32970
**SUPERCONDUCTORS**
Performance of a high T(sub c) superconducting ultra-low loss microwave stripline filter N91-32255
X ray absorption fine structure of systems in the anharmonic limit
[DE91-016070] N91-32892
Magnetic relaxation of the organic superconductor kappa-(BEDT-TTF)2Cu(N(CN)2)Br
[DE91-016528] N91-32969
**SUPERCOOLING**
Laboratory and field studies of stratospheric aerosols: Phase changes under high supersaturation N91-32533
**SUPERCRITICAL PRESSURES**
Regenerative fuel cell architectures for lunar surface power N91-32560
**SUPERLATTICES**
An overview of the electronic properties of InAs(1-x)Sb(x) strained-layer superlattices (O less than or equal to x less than or equal to 1)
[DE91-017458] N91-32976
**SUPERNOVAE**
Nuclear and astronomical constraints on the site for r-process nucleosynthesis
[DE91-016561] N91-33038
**SUPERPLASTICITY**
Microstructural change and its influence on stress-strain behavior of two superplastic materials
[DE91-017431] N91-32980
**SUPERSATURATION**
Laboratory and field studies of stratospheric aerosols: Phase changes under high supersaturation N91-32533
**SUPERSONIC COMBUSTION**
An experimental investigation of a supersonic vortical flow
[NASA-TM-105102] N91-32085
**SUPERSONIC COMBUSTION RAMJET ENGINES**
Numerical calculation of flow for scramjet engine N91-32035
Supersonic mixing enhancement by vorticity for high-speed propulsion
[NASA-CR-188920] N91-32079
**SUPERSONIC COMPRESSORS**
Numerical turbulent simulations of unsteady transonic cascade flows N91-32063
**SUPERSONIC FLOW**
Supersonic inlet flow computations with cavity N91-32049
Investigation of radiative interactions in supersonic internal flows
[NASA-CR-188820] N91-32078
Supersonic mixing enhancement by vorticity for high-speed propulsion
[NASA-CR-188920] N91-32079
**SUPERSONIC INLETS**
The role of computational fluid dynamics in aeronautical engineering (8): A mixed compression inlet for a supersonic airplane N91-32048

Supersonic inlet flow computations with cavity N91-32049

**SUPERSONIC JET FLOW**
An experimental investigation of a supersonic vortical flow
[NASA-TM-105102] N91-32085

**SUPPRESSORS**
Circuit protection devices for transient suppression N91-32732

**SURFACE CRACKS**
Load-line displacements for three-point bend J tests using bottom surface displacements
[AD-A229634] N91-32518

**SURFACE FINISHING**
Surface modification of high-strength reinforcing fibers by plasma treatment
[DE91-016481] N91-32226

**SURFACE PROPERTIES**
The effect of chemical additives on the synthesis of ethanol
[DE91-016586] N91-32192
Measurement of interfacial area using four sensor probe in two phase flow
[DE91-017415] N91-32466
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy
[DE91-016571] N91-32917

**SURFACE REACTIONS**
Photogenerated carrier-induced reactions on semiconductor surfaces
[DE91-017550] N91-32416

**SURFACE TEMPERATURE**
Dynamics of surface melting
[DE91-016344] N91-32206

**SURFACE WATER**
An optical multichannel analyser based large volume reflectometer
[BCRS-90-37] N91-32469

**SURFACE WAVES**
Numerical simulation of turbulent convection over wavy surfaces
[DLR-FB-91-12] N91-32439
Near ground sound propagation in wind
[CSTB-2-89-003-4] N91-32871

**SURGERY**
Medical evaluations on the KC-135 1990 flight report summary
[NASA-TM-104740] N91-32776
Minor surgery in microgravity N91-32786
Fluid handling 2: Surgical applications N91-32790
Deployment and testing of a second prototype expandable surgical chamber in microgravity N91-32794

**SURGES**
The performance of cable braids and terminations to lightning induced transients N91-32611
Designs for surge immunity in critical electronic facilities N91-32635
Diffuse dispersive delay and the time convolution/attenuation of transients N91-32730
Circuit protection devices for transient suppression N91-32732

**SURGICAL INSTRUMENTS**
Minor surgery in microgravity N91-32786

**SURVEILLANCE**
The First Annual International Satellite Surveillance and Communication Symposium
[DOT/FAA/RD-91/21] N91-32093
Automatic Dependent Surveillance (ADS) Program summary N91-32094
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
International Civil Aviation Organization (ICAO) Automatic Dependent Surveillance Panel (ADSP) activities N91-32097
International program summary N91-32098
Automatic dependent surveillance Pacific engineering trials N91-32099
ADS (Automatic Dependent Surveillance) PET (Pacific Engineering Trial) program in Japan N91-32100
Australian experiments in Automatic Dependent Surveillance (ADS) including the Pacific Engineering Trials (PET) N91-32101
Automatic Dependent Surveillance (ADS) development in Canada N91-32104
The FAA/ARINC initial implementation of AMSS N91-32112
Use of ISO protocols in the ADS environment N91-32115
Near-term satellite-based oceanic air traffic control: Ground system description N91-32116
Impact of automation and data link enhancements on oceanic air traffic control N91-32117
US oceanic air traffic control: Past, present, and future N91-32118
Preliminary evaluation of ADS/radar correlation N91-32119
Cooperative ADS/AAS integration N91-32120
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
Satellite surveillance and communications airline benefits: The telephone myth N91-32124

**SURVEYS**
Analog-to-digital conversion techniques
[AD-A239469] N91-32796
Working Papers: Astronomy and Astrophysics Panel Reports
[NASA-CR-188785] N91-33017

**SUSPENDING (MIXING)**
Channel flow of a concentrated suspension
[DE91-016649] N91-32453
Numerical study of Stokes flows with suspended particles
[DE91-017011] N91-32455

**SWIRLING**
An experimental investigation of a supersonic vortical flow
[NASA-TM-105102] N91-32085

**SWITCHES**
Planar gallium arsenide NPNP microwave switch
[AD-D014948] N91-32398
Performance of a 10 kV, 625 kA, 85 kJ energy discharge module utilizing a solid dielectric switch
[DE91-017432] N91-32409
Wideband microwave generation with GaAs photoconductive switches
[DE91-017544] N91-32415

**SWITCHING CIRCUITS**
Design criteria for a magnetic switch when used to discharge a pulse forming line
[DE91-016559] N91-32402
Low-cost 3 kV, triggered, stripline, surface-discharge switch
[DE91-016641] N91-32403
Neutron, gamma ray and post-irradiation thermal annealing effects on power semiconductor switches
[NASA-TM-105248] N91-32410
High average power magnetic modulator for copper lasers
[DE91-016560] N91-32482

**SYMBOLS**
Symbol lock detection in the ARX 2 and Block 5 receivers N91-32261

**SYNCHROTRON RADIATION**
High-energy synchrotron radiation x ray microscopy: Present status and future prospects
[DE91-016894] N91-32893

**SYNCHROTRONS**
Photon stimulated desorption from aluminum and stainless steel
[DE91-017007] N91-32211
High-energy synchrotron radiation x ray microscopy: Present status and future prospects
[DE91-016894] N91-32893

**SYNOPTIC METEOROLOGY**
Research on diabatic initialization N91-32671
Nonlinear feedbacks between stratocumulus and synoptic-scale systems N91-32674
Synoptic/planetary-scale interactions and blocking over the North Atlantic Ocean N91-32692
Precipitation regime changes associated with climatic changes
[PB91-206656] N91-32740

**SYNTHESIS (CHEMISTRY)**
The effect of chemical additives on the synthesis of ethanol
[DE91-016586] N91-32192
High octane ethers from synthesis gas-derived alcohols
[DE91-016596] N91-32193
Multiheteromacrocycles that complex metal ions
[DE91-016292] N91-32205
Silver lined ceramic vessel and method of preparation
[AD-D014953] N91-32224
Astrophysical neutron capture processes
[DE91-017071] N91-33039

**SYNTHESIZERS**
Design and status of the RF-digitizer integrated circuit N91-32262

**SYNTHETIC APERTURE RADAR**
Synthetic aperture radar imagery of airports and surrounding areas: Study of clutter at grazing angles and their polarimetric properties
[NASA-CR-4398] N91-32088
Generation of topographic terrain models utilizing synthetic aperture radar and surface level data
[NASA-CASE-GSC-13212-1] N91-32546

**SYSTEM IDENTIFICATION**
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253

**SYSTEMS ANALYSIS**
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
Smart instruments and the national collaboratory
[NASA-CR-188902] N91-32472
IDEF3 and IDEF4 automation system requirements document and system environment models
[NASA-CR-188829] N91-32804
Finiteness: On constraints of applied research
[DLR-MITT-91-06] N91-33001
Reliability and cost: A sensitivity analysis
[NASA-TM-105293] N91-33014

**SYSTEMS ENGINEERING**
Federal radionavigation plan, 1990
[PB91-190868] N91-32091
Human-centered aircraft automation: A concept and guidelines
[NASA-TM-103885] N91-32135
ART-Ada: An Ada-based expert system tool
[NASA-CR-188930] N91-32837
Evaluation of knowledge-based system development tools
[DE91-017241] N91-32860
International workshop on cold neutron sources
[DE91-017559] N91-32891
Development of a handbook for configuration managers with applications for the program/system in full-scale development
[AD-A229617] N91-32993
Finiteness: On constraints of applied research
[DLR-MITT-91-06] N91-33001

**SYSTEMS INTEGRATION**
Cooperative ADS/AAS integration N91-32120
Operational oceanic air traffic control using satellite data link: Initial implementation N91-32121
Flight operations and air traffic management integration N91-32122
Application of an integrated flight/propulsion control design methodology to a STOVL aircraft
[NASA-TM-105254] N91-32143
Advanced visualization techniques N91-32669

**SYSTEMS MANAGEMENT**
Federal radionavigation plan, 1990
[PB91-190868] N91-32091

## T

**TABLES (DATA)**
Cray performance data from five benchmarks
[NASA-TM-105200] N91-32806

**TAILLESS AIRCRAFT**
On the maximum range of flying wings
[AD-A229487] N91-32130

**TANDEM MIRRORS**
Axial pressure profile effects on flute interchange stability in the tandem mirror GAMMA 10
[NIFS-98] N91-32934

**TANKS (CONTAINERS)**
Cryogenic Orbital Nitrogen Experiment (CONE): Phase A/B design study
[NASA-CR-187230] N91-32166

**TARGET ACQUISITION**
Maximum likelihood estimation applied to target motion analysis using second order derivatives
[FEL-89-A193] N91-32862

**TARGET RECOGNITION**
Maximum likelihood estimation applied to target motion analysis using second order derivatives
[FEL-89-A193] N91-32862

**TARGETS**
Charge transfer during individual collisions in ice growing by riming N91-32727
Computer simulation studies of high energy collision cascades
[DE91-016225] N91-32903
The promise of magnetized fuel: High gain in inertial confinement fusion
[DE91-016321] N91-32937

**TEA LASERS**
Refinement of a pulsed CO2-laser rangefinder with heterodyne detection
[FEL-90-A303] N91-32477

**TECHNOLOGICAL FORECASTING**
Progress in submicron technologies N91-32394

**TECHNOLOGY ASSESSMENT**
Scouting the neighborhood: In our lifetime
[DE91-017083] N91-32151
MPD thruster technology
[NASA-TM-105242] N91-32162

Cost effective electronic components for short life space missions N91-32387
Technology approval using capability indices N91-32389
Progress in submicron technologies N91-32394
Energy and technology review [DE91-016873] N91-32572
SERI Solar Radiation Resource Assessment Project [DE91-002164] N91-32575
An assessment of the connection machine [NASA-CR-188876] N91-32801
Collaboration technology and space science [NASA-CR-188861] N91-32846
Working Papers: Astronomy and Astrophysics Panel Reports [NASA-CR-188785] N91-33017
Radio astronomy N91-33018
UV-optical from space N91-33021
High energy from space N91-33023

**TECHNOLOGY TRANSFER**
Benefits to the nation from astronomy and astrophysics N91-33030

**TECHNOLOGY UTILIZATION**
Materials compatibility issues for fabric composite radiators [DE91-017556] N91-32186

**TEKTITES**
Leaching behavior of microtektite glass compositions in sea water and the effect of precipitation on glass leaching [NASA-TM-105106] N91-32225

**TELECOMMUNICATION**
The Telecommunications and Data Acquisition Report [NASA-CR-188813] N91-32250

**TELECONNECTIONS (METEOROLOGY)**
Potential vorticity index N91-32672

**TELEMETRY**
The Advanced Receiver II telemetry test results at Goldstone N91-32260
A carrier-arraying demonstration at Goldstone for receiving Pioneer 11 signals N91-32273
Application of telerobotic control to remote processing of nuclear material [DE91-016562] N91-32501

**TELEOPERATORS**
Telerobot control system [NASA-CASE-NPO-18116-1-CU] N91-32509
A generalized compliant motion primitive [NASA-CASE-NPO-18134-1-CU] N91-32510
Collaboration technology and space science [NASA-CR-188861] N91-32846
Military robotics technologies at Sandia National Laboratories [DE91-016113] N91-32858

**TELEPHONES**
Satellite surveillance and communications airline benefits: The telephone myth N91-32124
Further identification and treatment modalities in telephone mediated lightning strike N91-32622

**TELEROBOTICS**
Application of telerobotic control to remote processing of nuclear material [DE91-016562] N91-32501
Robot development for nuclear material processing [DE91-016567] N91-32502

**TELESCOPES**
A lidar equipped with photon counter for measuring stratospheric aerosols N91-32540
Method and apparatus for phasing segmented mirror arrays [NASA-CASE-NPO-18095-1-CU] N91-32923
The decade of discovery in astronomy and astrophysics [NASA-CR-188226] N91-33016
Radio astronomy N91-33018
Optical/IR from ground N91-33020
SOFIA: A Stratospheric Observatory for Infrared Astronomy [NASA-TM-103840] N91-33033

**TELEVISION CAMERAS**
Laboratory test results of solid state video cameras [DE91-016189] N91-32399

**TEMPERATE REGIONS**
Lidar measurements at Garmisch, conversion model, and midlatitude aerosol effects N91-32536

**TEMPERATURE COMPENSATION**
Temperature compensation of PMOS dosimeters N91-32336

**TEMPERATURE DEPENDENCE**
Ionization of NO at high temperature [NASA-CR-188798] N91-32187
Inconsistencies with the single impurity Undersign model in photoelectron spectra of cerium heavy fermion compounds [DE91-016239] N91-32878
La(sup 139) NMR and NQR study of the temperature dependent structure of La2CuO4+(delta) [DE91-016201] N91-32959
Magnetically measured irreversibility temperatures in superconducting oxides and alloys [DE91-016895] N91-32972

**TEMPERATURE DISTRIBUTION**
A guidebook for the control of summer heat islands [DE91-016246] N91-32586

**TEMPERATURE EFFECTS**
Tensile and cyclic fatigue properties of SiC whisker-reinforced Al2O3 [DE91-015916] N91-32179
Materials compatibility issues for fabric composite radiators [DE91-017556] N91-32186
Effect of initial conditions on combustion generated loads [DE91-016646] N91-32194
Dynamics of surface melting [DE91-016344] N91-32206
Electronic transport properties in copper oxides [DE91-018182] N91-32213
Test on opto couplers in the linear application considering temperature, radiation and Vce effects N91-32314
Computational simulation of high temperature metal matrix composite behavior [NASA-TM-104378] N91-32520
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688

**TEMPERATURE INVERSIONS**
A guidebook for the control of summer heat islands [DE91-016246] N91-32586

**TEMPERATURE MEASUREMENT**
A comparison of the analytical and experimental performance of the solid version of a cooled radial turbine [NASA-CR-187195] N91-32077
Picosecond time-resolved electron diffraction studies of laser heated metals [DE91-016345] N91-32207
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 1: Design and ground tests N91-32269
Measurements of some parameters of thermal sparks with respect to their ability to ignite aviation fuel/air mixtures N91-32705

**TEMPERATURE PROBES**
Picosecond time-resolved electron diffraction studies of laser heated metals [DE91-016345] N91-32207

**TEMPERATURE PROFILES**
An H-mode-like bifurcation in core plasma of stellarators [NIFS-97] N91-32933
Heat deposition on the partial limiter [NIFS-28] N91-32954

**TEMPORAL DISTRIBUTION**
Potential vorticity index N91-32672

**TENSILE PROPERTIES**
Tensile and cyclic fatigue properties of SiC whisker-reinforced Al2O3 [DE91-015916] N91-32179

**TENSILE STRESS**
A study of fracture mechanisms in ATD roller bearing [NASA-CR-184200] N91-32497

**TENSILE TESTS**
Standards for polymer matrix composites. Part 2: Assessment and comparison of CRAG test methods [NPL-DMM(A)-7-PT-2] N91-32174
Structural characterization of high temperature composites [NASA-CR-187220] N91-32180

**TERMINOLOGY**
Environment, Safety and Health Thesaurus/Dictionary [DE91-013428] N91-33012

**TERMS**
ICBM abbreviations and acronyms (2nd edition) [PB91-193375] N91-33011

**TERRAIN**
Generation of topographic terrain models utilizing synthetic aperture radar and surface level data [NASA-CASE-GSC-13212-1] N91-32546

**TERRESTRIAL PLANETS**
Scouting the neighborhood: In our lifetime [DE91-017083] N91-32151

**TEST EQUIPMENT**
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 1: Design and ground tests N91-32269
Test structures and measurement techniques for radiation hardening N91-32332
Lightning testing at the subsystem level N91-32714

**TEST FACILITIES**
The pre-screening of large semiconductor memories for space application N91-32357
The Sandia transportable triggered lightning instrumentation facility N91-32636
A simulated lightning effects test facility for testing live and inert missiles and components N91-32725

**TESTING TIME**
An advanced testability concept for space applications N91-32323

**THALLIUM COMPOUNDS**
Irradiation effects in high temperature superconductors [DE91-016118] N91-32962

**THEMATIC MAPPERS (LANDSAT)**
Automatic land-use classification using LANDSAT-5 thematic mapper data in a region of the Itzehoer Geest. An attempt to improve mapping by combination with panchromatic SPOT data [DLR-FB-90-47] N91-32542
Parametric rectification of thematic mapper raw data [DLR-FB-90-55] N91-32543

**THEMATIC MAPPING**
Automatic land-use classification using LANDSAT-5 thematic mapper data in a region of the Itzehoer Geest. An attempt to improve mapping by combination with panchromatic SPOT data [DLR-FB-90-47] N91-32542
The 1980 equalization diagnosis of the German main triangulation network. 5: Neighborhood, conclusions --- thematic maps [SER-B-272-PT-2] N91-32548

**THEORETICAL PHYSICS**
Research program in elementary particle theory (task A) [DE91-016937] N91-32895

**THERMAL CONDUCTIVITY**
Heat transfer effectiveness of a thermal barrier coating with different fuel compositions [DE91-015602] N91-32222
Heat deposition on the partial limiter [NIFS-28] N91-32954
Cryogenic cooling of x ray crystals using porous matrix [DE91-017322] N91-32982

**THERMAL CONTROL COATINGS**
Heat transfer effectiveness of a thermal barrier coating with different fuel compositions [DE91-015602] N91-32222
New technologies for integrating thermal control, and radiation protection in hybrid technology N91-32330

**THERMAL DECOMPOSITION**
Matrix-dominated thermoviscoplasticity in fibrous metal-matrix composite materials N91-32173

**THERMAL DIFFUSIVITY**
Fluid dynamics of double diffusive systems [DE91-017401] N91-32465

**THERMAL EXPANSION**
Graphite-metal brazing for thermal applications [DE91-016647] N91-32944

**THERMAL INSULATION**
Ceramic coatings on smooth surfaces [NASA-CASE-LEW-15164-2] N91-32229

**THERMAL RADIATION**
The essential linearity of thermal radiation net transport [DE91-016734] N91-32990

**THERMAL RESISTANCE**
High performance packages for space applications: Review of packaging and assembly methods for long wavelength laser diodes N91-32318
MTSL-005: Reliability evaluation of high pincount hermetic ceramic packages for space applications N91-32328

**THERMAL SHOCK**
Projects within the Center for Advanced Materials [PB91-205716] N91-32178

**THERMAL STABILITY**
Formation and annealing behavior of an amorphous layer induced by tin implantation into sapphire [DE91-015929] N91-32960

**THERMAL STRESSES**
Advances in the design of toughened ceramics [DE91-016767] N91-32228
Simplified micromechanical equations for thermal residual stress analysis of coated fiber composites [NASA-CR-187599] N91-32527

**THERMISTORS**
The United Kingdom waveguide power standards above 40 GHz [NPL-DES-105] N91-32395

**THERMODYNAMIC EFFICIENCY**
Site-specific investigations on aquifer thermal energy storage for space and process cooling [DE91-017534] N91-32576

**THERMODYNAMIC EQUILIBRIUM**
Thermodynamics of combustion in an enclosure
[DE91-016430] N91-32992
**THERMODYNAMIC PROPERTIES**
Effect of initial conditions on combustion generated loads
[DE91-016646] N91-32194
Laser performance and optical properties of LiSrGaF6:Cr(3+)
[DE91-016555] N91-32481
Oxygen ordered superstructures and domain formation in YBa2Cu3O(7-x)
[DE90-015633] N91-32958
**THERMODYNAMICS**
Thermodynamic flow description of a ramjet for determination of engine forces and moments
[DLR-FB-91-02] N91-32139
High-temperature thermomechanical behavior of carbon-phenolic and carbon-carbon composites N91-32171
Fracture characterization for thermoinelasticity N91-32517
Monitoring, analyzing, and modeling global climate N91-32689
Thermodynamics of combustion in an enclosure
[DE91-016430] N91-32992
**THERMOLUMINESCENCE**
Laser heated calcium sulfate TLD plates: Application to radiation mapping N91-32364
**THERMONUCLEAR REACTIONS**
Astrophysical neutron capture processes
[DE91-017071] N91-33039
**THERMOPLASTIC RESINS**
Advanced thermoplastic resins, phase 2
[NASA-CR-187548] N91-32231
**THESAURI**
Environment, Safety and Health Thesaurus/Dictionary
[DE91-013428] N91-33012
**THIN FILMS**
Picosecond time-resolved electron diffraction studies of laser heated metals
[DE91-016345] N91-32207
Lubrication with sputtered MoS2 films: Principles, operation, limitations
[NASA-TM-105292] N91-32216
The role of photosensitive polyimides in the development of hybrid space hardware N91-32321
Magneto-optical record media
[DE91-017838] N91-32476
Tribological behavior of silver films prepared on ceramic surfaces by ion-beam-assisted deposition
[DE91-017306] N91-32505
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy
[DE91-016571] N91-32917
Soft x ray magnetic scattering study of thin films and multilayers
[DE91-017472] N91-32920
Irradiation effects in high temperature superconductors
[DE91-016118] N91-32962
Evidence for cation disorder in in-situ grown YBaCuO superconducting films
[DE91-016760] N91-32971
Application of a thermal spike model to experimental ion-induced grain growth data
[DE91-017320] N91-32981
**THIN WALLED SHELLS**
Method and apparatus for producing microshells
[NASA-CASE-NPO-16635-1-CU] N91-32240
**THIN WALLS**
Baryon inhomogeneity from the cosmic quark-hadron phase transition
[DE91-016608] N91-33051
**THOMSON SCATTERING**
Observations of Enhanced Radar Backscatter (ERB) from Millstone Hill
[NASA-CR-188877] N91-32280
Calibration source for electron cyclotron emission measurements
[NIFS-19] N91-32913
**THREE DIMENSIONAL FLOW**
Surface grid generation based on unstructured grid N91-32042
The three dimensional Navier-Stokes simulations of flow over a wing without any turbulent modelling N91-32051
Numerical analysis of three-dimensional cascade flow N91-32067
Navier-Stokes computations of three-dimensional turbine cascade flows N91-32068
Compressible flows with vortical disturbances around a cascade of airfoils N91-32083
Navier-Stokes flow calculations by an implicit non-centered method N91-32436
**THREE DIMENSIONAL MODELS**
Application of 3-D Navier-Stokes computation to turbine vane design N91-32069
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components
[NASA-CR-187196] N91-32524
A global simulation of the magnetosphere with a long tail: Southward and northward IMF
[NIFS-99] N91-32592
FD-TD calculation with composite materials. Application to C160 aircraft measurements N91-32637
Three-dimensional time domain model of lightning including corona effects N91-32702
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida
[DE91-017445] N91-32743
**THREE DIMENSIONAL MOTION**
RV strings of maximum curvature
[DE91-016708] N91-32157
Three dimensional moire pattern alignment
[NASA-CASE-MSC-21416-1] N91-32922
**THRESHOLD VOLTAGE**
Temperature compensation of PMOS dosimeters N91-32336
Space radiation effects on power MOSFET: Threshold-voltage shift with dose rate N91-32363
**THRUST VECTOR CONTROL**
Aerodynamics of combat aircraft controls and of ground effects
[AGARD-AR-271] N91-32082
**THRUST-WEIGHT RATIO**
A nuclear thermal rocket engine design based on the particle bed reactor suitable for a Mars mission
[DE91-016898] N91-32160
**THRUSTORS**
Multimegawatt electric propulsion system design considerations
[NASA-TM-105152] N91-32164
**THULIUM ISOTOPES**
Infrastructure for thulium-170 isotope power systems for autonomous underwater vehicle fleets
[DE91-017464] N91-32911
**THUNDERSTORMS**
Lightning threat to aircraft: Do we know all we need to know? N91-32600
Thunderstorm detection and warning system atmospheric potential monitor N91-32608
Lightning location system supervising Swedish power transmission network N91-32617
Range estimation techniques in single-station thunderstorm warning sensors based upon gated, wideband, magnetic direction finder technology N91-32618
Thunderstorm monitoring and lightning warning, operational applications of the Safir system N91-32619
The electric field change caused by a ground flash with multiple channels N91-32647
The detection of the electric field vertical distribution underneath thundercloud: Principle and applications N91-32653
Electrification in winter storms and the analysis of thunderstorm overflight N91-32678
Surface wind convergence as a short-term predictor of cloud-to-ground lightning at Kennedy Space Center: A four-year summary and evaluation N91-32703
Comparison of lightning location data and polarisation radar observations of clouds N91-32710
The spatial variations of lightning during small Florida thunderstorms N91-32711
Lightning to the upper atmosphere: A vertical light pulse from the top of a thunderstorm as seen by a payload bay TV camera of the space shuttle N91-32720
A study of point discharge current observations in the thunderstorm environment at a tropical station during the year 1987 and 1988 N91-32721
Severe thunderstorm cases of July 1989 thru June 1990
[PB91-201392] N91-32738
**THYRATRONS**
Development and operation of a solid-state switch for thyratron replacement
[DE91-016553] N91-32401
Reliable, high repetition rate thyratron grid driver used with a magnetic modulator
[DE91-016558] N91-32413
High average power magnetic modulator for copper lasers
[DE91-016560] N91-32482
**TIME DEPENDENCE**
E and DE/DT waveshapes for narrow bipolar pulses in intracloud lightning N91-32610
**TIME DIVISION MULTIPLEXING**
Data Multiplexing Network (DMN), phase 3: Equipment Operational Test and Evaluation (OT&E)/Integration test plan
[DOT/FAA/CT-TN91/24] N91-32283
**TIME OF FLIGHT SPECTROMETERS**
High energy spin waves in iron measured by neutron scattering
[DE91-017868] N91-32902
**TIN**
Formation and annealing behavior of an amorphous layer induced by tin implantation into sapphire
[DE91-015929] N91-32960
**TIN ALLOYS**
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325
**TIN COMPOUNDS**
An overview of the electronic properties of InAs(1-x)Sb(x) strained-layer superlattices (O less than or equal to x less than or equal to 1)
[DE91-017458] N91-32976
**TITANIUM ALLOYS**
Graphite-metal brazing for thermal applications
[DE91-016647] N91-32944
**TITANIUM COMPOUNDS**
Advances in Li-TiS2 cell technology N91-32567
**TOKAMAK DEVICES**
H-mode physics: Experimental observations and model theories. Lecture notes
[NIFS-92] N91-32930
Geometric dependence of the scaling law on the energy confinement time in H-mode discharges
[NIFS-93] N91-32931
ELMy-H mode as limit cycle and chaotic oscillations in tokamak plasmas
[NIFS-96] N91-32932
Heavy Neutral Beam Probe for edge plasma analysis in tokamaks
[DE91-016290] N91-32935
L to H mode transitions and associated phenomena in divertor tokamaks
[DE91-017074] N91-32940
Advanced fusion diagnostics
[DE91-017412] N91-32941
Initial operational experience after installation of the D3-D radiation shield
[DE91-017765] N91-32949
Edge electric field profiles of H-mode plasmas in JFT-2M tokamak
[NIFS-26] N91-32956
**TOLERANCES (MECHANICS)**
Materials and processes laboratory composite materials characterization task, part 1. Damage tolerance
[NASA-TM-103553] N91-32185
**TOPOGRAPHY**
Generation of topographic terrain models utilizing synthetic aperture radar and surface level data
[NASA-CASE-GSC-13212-1] N91-32546
**TOPOLOGY**
Electromagnetic topology: Characterization of internal electromagnetic coupling N91-32699
**TOROIDAL PLASMAS**
Heat deposition on the partial limiter
[NIFS-28] N91-32954
**TORQUE**
Dynamics modeling and control of a flexible robot arm N91-32495
**TORSIONAL VIBRATION**
Aeroelastic flutter prevention in gliders and small aircraft
[DLR-MITT-91-03] N91-32142
**TOUGHNESS**
Advances in the design of toughened ceramics
[DE91-016767] N91-32228
**TOWERS**
Characteristics of winter lightning currents struck an isolated tower N91-32607
The electric field change caused by a ground flash with multiple channels N91-32647
Discussions on a long gap discharge to an EHV transmission tower by a rocket triggered lightning experiment N91-32654
**TOXICITY**
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770
**TRACERS**
Chemical tracer studies at IOSDL-2: A method manual for the routine measurement of chlorofluocarbons in seawater and air
[IOS-275] N91-32580
**TRACKING (POSITION)**
Cooperative ADS/AAS integration N91-32120
GEOPLOT: User guide and programmer's guide
[IOS-279] N91-32745
**TRAILING EDGES**
Lightning protection of the Fokker 100 CFRP rudder N91-32612
**TRAINING DEVICES**
Energy and technology review
[DE91-016873] N91-32572

Aircrew part-task training research and development in the 1980s: Lessons learned
[AD-A239456] N91-32773

**TRAINING EVALUATION**
Study of the predictive validity of a psychological selection procedure for air-traffic controllers based on training criteria
[DLR-FB-91-11] N91-32090

**TRAINING SIMULATORS**
Simulator sickness N91-32765
An intelligent tutoring system for the investigation of high performance skill acquisition
[NASA-CR-188827] N91-32827

**TRAJECTORIES**
A generalized compliant motion primitive
[NASA-CASE-NPO-18134-1-CU] N91-32510
Gaussian elimination methods for calculating classical periodic trajectories in two dimensions
[DE91-017600] N91-32869

**TRAJECTORY ANALYSIS**
RV strings of maximum curvature
[DE91-016708] N91-32157

**TRAJECTORY CONTROL**
A unified motion planning approach for redundant and nonredundant manipulators with actuator constraints N91-32494
Dynamics modeling and control of a flexible robot arm N91-32495

**TRAJECTORY OPTIMIZATION**
Optimal control problems with switching points
[NASA-CR-4393] N91-32155

**TRAJECTORY PLANNING**
A unified motion planning approach for redundant and nonredundant manipulators with actuator constraints N91-32494

**TRANSFER FUNCTIONS**
Spectral transfer analysis for subgrid-scale modelling N91-32438
Measurement of modulation transfer function for four types of imaging elements used in fast cameras
[DE91-017399] N91-32475

**TRANSFER OF TRAINING**
Energy and technology review
[DE91-016873] N91-32572

**TRANSFERRING**
Precision metering of microliter volumes of biological fluids in micro-gravity N91-32792

**TRANSFORMATIONS (MATHEMATICS)**
Surface grid generation based on unstructured grid N91-32042

**TRANSFORMERS**
How to create ball lightning N91-32728

**TRANSISTOR AMPLIFIERS**
A cooled 1- to 2-GHz balanced HEMT amplifier N91-32254

**TRANSITION FLIGHT**
Application of an integrated flight/propulsion control design methodology to a STOVL aircraft
[NASA-TM-105254] N91-32143

**TRANSITION FLOW**
Basic studies of baroclinic flows N91-32662

**TRANSITION METALS**
Magneto-optical record media
[DE91-017838] N91-32476

**TRANSMISSION LINES**
Equivalent circuit model of traveling-wave maser slow-wave structures N91-32256
Further identification and treatment modalities in telephone mediated lightning strike N91-32622
The electric field change caused by a ground flash with multiple channels N91-32647
Influence of channel base current and varying return stroke speed on the calculated fields of three important return stroke models N91-32736

**TRANSMISSIONS (MACHINE ELEMENTS)**
Time-frequency domain analysis of helicopter transmission vibration
[ARL-PROP-R-180] N91-32146

**TRANSMUTATION**
Advanced high brightness ion RF accelerator applications in the nuclear energy
[DE91-016075] N91-32905

**TRANSOCEANIC FLIGHT**
System improvements identified by the North Atlantic Systems Planning Group (NAT/SPG) as related to the capabilities of the Oceanic Display and Planning System (ODAPS) N91-32109

**TRANSONIC COMPRESSORS**
Unsteady flow analysis in two-dimensional compressor cascade N91-32064

**TRANSONIC FLOW**
Navier-Stokes simulation for complete aircraft configuration N91-32046
Numerical turbulent simulations of unsteady transonic cascade flows N91-32063
Thin layer Navier-Stokes solutions for transonic multibody interference
[AD-A234252] N91-32072
Computational turbulence studies in Turkey N91-32449

**TRANSPORT AIRCRAFT**
An example of requirements for Advanced Subsonic Civil Transport (ASCT) flight control system using structured techniques
[NASA-CR-187526] N91-32132

**TRANSPORT PROPERTIES**
Hamiltonian chaos and transport in quasigeostrophic flows
[DE91-017385] N91-32464
H-mode physics: Experimental observations and model theories. Lecture notes
[NIFS-92] N91-32930

**TRANSPORT VEHICLES**
Bidirectional drive and brake mechanism
[NASA-CASE-MSC-21540-1] N91-32514

**TRANSPORTER**
Performance enhancement using power beaming for electric propulsion Earth orbital transporters
[DE91-017287] N91-32168

**TRANSPUTERS**
Radiation assessment of the INMOS transputer family N91-32358

**TRAVELING WAVE MASERS**
Equivalent circuit model of traveling-wave maser slow-wave structures N91-32256

**TRAVELING WAVES**
Tropical Pacific moisture variability N91-32690

**TREES (MATHEMATICS)**
Evolutionary tree reconstruction
[NASA-CR-188862] N91-32816

**TREES (PLANTS)**
A guidebook for the control of summer heat islands
[DE91-016246] N91-32586

**TRELLIS CODING**
Multi-dimensional modulation codes for fading channel
[NASA-CR-188959] N91-32288

**TRIANGULATION**
Integrated compensation of geodetic nets in point masses model
[SER-C-362] N91-32547
The 1980 equalization diagnosis of the German main triangulation network. 5: Neighborhood, conclusions --- thematic maps
[SER-B-272-PT-2] N91-32548

**TRIBOLOGY**
Lubrication with sputtered MoS2 films: Principles, operation, limitations
[NASA-TM-105292] N91-32216
Tribological behavior of silver films prepared on ceramic surfaces by ion-beam-assisted deposition
[DE91-017306] N91-32505

**TRIGGER CIRCUITS**
Low-cost 3 kV, triggered, stripline, surface-discharge switch
[DE91-016641] N91-32403

**TRIPODS**
Algorithms for structural natural-frequency design N91-32252

**TROPICAL METEOROLOGY**
Research on diabatic initialization N91-32671

**TROPICAL REGIONS**
Research on diabatic initialization N91-32671
WetNet: Using SSM/I data interactively for global distribution of rainfall and precipitable water N91-32685
Tropical Pacific moisture variability N91-32690
South Pacific convergence zone and global scale circulations (Jul. 1987 - Jul. 1991). Observational and modeling studies of heat, moisture, precipitation, and global-scale circulation patterns (Jul. 1990 - Jul. 1993) N91-32691
A study of point discharge current observations in the thunderstorm environment at a tropical station during the year 1987 and 1988 N91-32721

**TROPOSPHERE**
In situ measurements of light extinction of stratospheric aerosols N91-32541
Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere N91-32673
NOAA backscatter studies N91-32679
Beta measurements N91-32681
Global temperature variations N91-32683
Tropical Pacific moisture variability N91-32690

**TSUNAMI WAVES**
UJNR Tsunami Workshop Proceedings
[PB91-193656] N91-32747

**TUNING**
Tuning and matching of the BPX ICH system
[DE91-017872] N91-32950

**TURBINE ENGINES**
Cost effectiveness of two versus three levels of maintenance for turbine engines in the Air Force inventory
[AD-A229622] N91-32137

**TURBINES**
Navier-Stokes computations of three-dimensional turbine cascade flows N91-32068
Application of 3-D Navier-Stokes computation to turbine vane design N91-32069

**TURBOFAN ENGINES**
Investigation of advanced counterrotation blade configuration concepts for high speed turboprop systems. Task 3: Advanced fan section grid generator final report and computer program user's manual
[NASA-CR-187129] N91-32138
Preliminary flight evaluation of an engine performance optimization algorithm
[NASA-TM-4328] N91-32140

**TURBOMACHINERY**
Numerical analysis of three-dimensional cascade flow N91-32067

**TURBULENCE**
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441

**TURBULENCE EFFECTS**
A laser velocimeter investigation of the normal shock-wave boundary layer interaction
[NASA-TM-105201] N91-32440

**TURBULENCE MODELS**
Numerical simulation of unsteady compressible viscous flows using an implicit upwind relaxation scheme N91-32041
Wall function method with conservation property N91-32058
Unsteady flow analysis in two-dimensional compressor cascade N91-32064
Appraisal of the Suitability of Turbulence Models in Flow Calculations
[AGARD-AR-291] N91-32443
Turbulence modelling: Survey of activities in Belgium and The Netherlands, an appraisal of the status and a view on the prospects N91-32444
Calculation of turbulent compressible flows N91-32445
Turbulence models for natural convection flows along a vertical heated plane N91-32447
Turbulent flow modelling in Spain: Overview and developments N91-32448
Appraisal of the suitability of turbulence models in flow calculations: A UK view on turbulence models for turbulent shear flow calculations N91-32450
Collaborative testing of turbulence models N91-32451

**TURBULENT BOUNDARY LAYER**
An experimental study of fluctuating pressure loads beneath swept shock/boundary-layer interactions
[NASA-CR-188919] N91-32080
Numerical simulation of turbulent convection over wavy surfaces
[DLR-FB-91-12] N91-32439
Turbulence modelling: Survey of activities in Belgium and The Netherlands, an appraisal of the status and a view on the prospects N91-32444
Turbulent flow modelling in Spain: Overview and developments N91-32448
Collaborative testing of turbulence models N91-32451
A k-epsilon modeling of near wall turbulence
[NASA-TM-105238] N91-32460
Temporal and spectral features of wall pressure fluctuations beneath a turbulent boundary layer N91-32461

**TURBULENT FLOW**
Navier-Stokes simulation for complete aircraft configuration N91-32046
Turbulence model calculations on the effects of body forces on turbulent flows in a pipe N91-32056
Wall function method with conservation property N91-32058
Numerical turbulent simulations of unsteady transonic cascade flows N91-32063
Studies in premixed combustion
[DE91-016964] N91-32198
Numerical study of partitioned turbulence
[ONERA-RSF-20/3419-AY-124A] N91-32437
Turbulence modelling: Survey of activities in Belgium and The Netherlands, an appraisal of the status and a view on the prospects N91-32444
Calculation of turbulent compressible flows N91-32445
Some current approaches in turbulence modelling N91-32446

Turbulent flow modelling in Spain: Overview and developments N91-32448
Appraisal of the suitability of turbulence models in flow calculations: A UK view on turbulence models for turbulent shear flow calculations N91-32450
Collaborative testing of turbulence models N91-32451
A k-epsilon modeling of near wall turbulence [NASA-TM-105238] N91-32460
A two-dimensional dynamic mix model in free Lagrange hydrodynamics [DE91-017661] N91-32467

**TURBULENT JETS**
An experimental study of natural and forced modes in an axisymmetric jet [NASA-TM-105225] N91-32074

**TURBULENT MIXING**
An experimental study of natural and forced modes in an axisymmetric jet [NASA-TM-105225] N91-32074
Supersonic mixing enhancement by vorticity for high-speed propulsion [NASA-CR-188920] N91-32079
An experimental investigation of a supersonic vortical flow [NASA-TM-105102] N91-32085
Turbulent flow modelling in Spain: Overview and developments N91-32448

**TVD SCHEMES**
Numerical calculation of flow for scramjet engine N91-32035
Numerical simulation of unsteady compressible viscous flows using an implicit upwind relaxation scheme N91-32041
Navier-Stokes simulation for complete aircraft configuration N91-32046
The role of computational fluid dynamics in aeronautical engineering (8): A mixed compression inlet for a supersonic airplane N91-32048
The three dimensional Navier-Stokes simulations of flow over a wing without any turbulent modelling N91-32051

**TWO DIMENSIONAL BODIES**
Contour-map encoding of shape for early vision [NASA-CR-188937] N91-32545

**TWO DIMENSIONAL FLOW**
Numerical simulation analysis of sidewall effects in two-dimensional wind tunnels N91-32050
Wall function method with conservation property N91-32058
A numerical simulation of two dimensional shear layer N91-32060
A general analysis of two-dimensional convection schemes N91-32428
Navier-Stokes flow calculations by an implicit non-centered method N91-32436

**TWO DIMENSIONAL MODELS**
Determining finite volume elements for the 2D Navier-Stokes equations [DE91-016028] N91-32452
A two-dimensional dynamic mix model in free Lagrange hydrodynamics [DE91-017661] N91-32467
A study of the magnetosphere-ionosphere coupling processes N91-32595

**TWO PHASE FLOW**
Appraisal of the Suitability of Turbulence Models in Flow Calculations [AGARD-AR-291] N91-32443
Measurement of interfacial area using four sensor probe in two phase flow [DE91-017415] N91-32466

## U

**ULTRAHIGH FREQUENCIES**
The electric field changes and UHF radiations caused by the triggered lightning in Japan N91-32652

**ULTRAHIGH VACUUM**
Versatile, low-cost, computer-controlled, sample positioning system for vacuum applications [NASA-CR-187144] N91-32237

**ULTRAVIOLET PHOTOMETRY**
Photobiological investigations on spores of Streptomyces griseus [DLR-FB-91-14] N91-32748

**ULTRAVIOLET SPECTROMETERS**
Vertical mixing and methane photochemistry in the atmosphere of Uranus: Analysis of Voyager UVS occultation experiments [NASA-CR-188789] N91-33042

**UNDERWATER ACOUSTICS**
Maximum likelihood estimation applied to target motion analysis using second order derivatives [FEL-89-A193] N91-32862

**UNDERWATER VEHICLES**
Infrastructure for thulium-170 isotope power systems for autonomous underwater vehicle fleets [DE91-017464] N91-32911

**UNITED STATES**
Historical sunshine and cloud data in the United States [DE91-016825] N91-32741
Japan-US Liaison Group on Joint Databases Development [PB91-214056] N91-33006

**UNIVERSE**
Particle astrophysics N91-33024

**UNIVERSITIES**
Energy and technology review [DE91-016873] N91-32572

**UNIX (OPERATING SYSTEM)**
GOOSE: A Generalized Object-Oriented Simulation Environment [DE91-016771] N91-32842

**UNSTEADY AERODYNAMICS**
Unstructured-grid methods development for unsteady aerodynamic and aeroelastic analyses [NASA-TM-104143] N91-32084

**UNSTEADY FLOW**
On the parallel processing of Direct Simulation Monte Carlo method N91-32037
Numerical simulation of unsteady compressible viscous flows using an implicit upwind relaxation scheme N91-32041
Several issues of visualization techniques in computational fluid dynamics 2 N91-32044
Numerical analysis of bubbly liquid in convergent-divergent nozzle N91-32052
Numerical turbulent simulations of unsteady transonic cascade flows N91-32063
Unsteady flow analysis in two-dimensional compressor cascade N91-32064
Unsteady flowfield of a propfan at takeoff conditions [NASA-TM-105223] N91-32075
Spectral element methods for the unsteady Navier-Stokes equations N91-32432
Calculation of unsteady linearized Euler flows in cascades using harmonically deforming grids [NASA-CR-188916] N91-32442
Appraisal of the Suitability of Turbulence Models in Flow Calculations [AGARD-AR-291] N91-32443
Computational turbulence studies in Turkey N91-32449

**UPLINKING**
Operational oceanic air traffic control using satellite data link: Initial implementation N91-32121

**UPPER ATMOSPHERE**
On the nonlinear response of minor atmospheric species to linear gravity waves N91-32593
Lightning to the upper atmosphere: A vertical light pulse from the top of a thunderstorm as seen by a payload bay TV camera of the space shuttle N91-32720

**UPWELLING WATER**
Tropical Pacific moisture variability N91-32690

**URANIUM OXIDES**
The application of time-resolved luminescence spectroscopy to a remote uranyl sensor [DE91-016310] N91-32189

**URANUS ATMOSPHERE**
Vertical mixing and methane photochemistry in the atmosphere of Uranus: Analysis of Voyager UVS occultation experiments [NASA-CR-188789] N91-33042

**USER MANUALS (COMPUTER PROGRAMS)**
Investigation of advanced counterrotation blade configuration concepts for high speed turboprop systems. Task 3: Advanced fan section grid generator final report and computer program user's manual [NASA-CR-187129] N91-32138
GEOPLOT: User guide and programmer's guide [IOS-279] N91-32745
User documentation for the MSK and OMS intelligent tutoring systems [NASA-CR-188815] N91-32823
Vehicle Animation Software (VAS) to animate results obtained from vehicle handling and rollover simulations and tests [PB91-194142] N91-32832
User's manual for PANDA 2: A computer code for calculating equations of state [DE91-017717] N91-32843

**USER REQUIREMENTS**
Model calculations for a pushbroom stereo camera: The case of the Mars 94 High Resolution Stereo Camera (HRSC) [DLR-FB-90-57] N91-32468
IDEF3 and IDEF4 automation system requirements document and system environment models [NASA-CR-188829] N91-32804
Beyond formalism [NASA-CR-188886] N91-32819
User documentation for the MSK and OMS intelligent tutoring systems [NASA-CR-188815] N91-32823
Identification of essential success factors for an electronic master publication library [AD-A229624] N91-33004

**UTILIZATION**
Examinations of the rational utilization of the Global Positioning System (GPS) in local networks [SER-C-361] N91-32129

## V

**VACUUM CHAMBERS**
Mating and unmating of multi-pin connectors under vacuum N91-32319

**VALENCE**
Inconsistencies with the single impurity Undersign model in photoelectron spectra of cerium heavy fermion compounds [DE91-016239] N91-32878

**VANES**
Application of 3-D Navier-Stokes computation to turbine vane design N91-32069
Review of Air Force compressor blade and vane rework and it's impact on performance and costs [AD-A229518] N91-32136

**VAPORIZING**
Shock-vaporization studies on zinc and porous carbon [DE91-017846] N91-32233

**VARIABILITY**
Tropical Pacific moisture variability N91-32690

**VARIATIONAL PRINCIPLES**
A new variational formulation of kinetic plasma theory and the application of moving finite elements [DE91-016072] N91-32938

**VARNISHES**
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada [NASA-CR-183493] N91-32591

**VECTOR PROCESSING (COMPUTERS)**
Lanczos eigensolution method for high-performance computers [NASA-TM-104108] N91-32526

**VEGETATION GROWTH**
Modeling the response of plants and ecosystems to global change [DE91-017403] N91-32587

**VELOCITY DISTRIBUTION**
Methods for the automatic de-aliasing of the Doppler velocity of a weather radar [DLR-FB-91-08] N91-32249

**VELOCITY MEASUREMENT**
Component local velocities of a ship along a defined axis [ARE-TM(UHR)-91305] N91-32424
Measurements of some parameters of thermal sparks with respect to their ability to ignite aviation fuel/air mixtures N91-32705

**VERTICAL DISTRIBUTION**
Measurements N91-32530
Characterization of vertical electric fields and associated voltages induced on a overhead power line from close artificially initiated lightning N91-32629
The detection of the electric field vertical distribution underneath thundercloud: Principle and applications N91-32653

**VERY HIGH FREQUENCIES**
Aeronautical mobile satellite services ESA-PRODAT/SITA AIRCOM service trials programme N91-32106
VHF discharges in storm cells producing microbursts N91-32620
A system for mapping sources of VHF and electric field pulses from in-cloud lightning at KSC N91-32697

**VERY LARGE SCALE INTEGRATION**
Testing interconnected VLSI circuits in the Big Viterbi Decoder N91-32265
Assessment of DFT strategies N91-32301
Radiation assessment of complex technologies N91-32342
Trends in latch-up sensitivity N91-32345

**VERY LONG BASE INTERFEROMETRY**
Delta VLBI data performance in the Galileo spacecraft Earth flyby of December 1990 N91-32274
JPL 1990-3: A 5-nrad extragalactic source catalog based on combined radio interferometric observations N91-32276

**VERY LOW FREQUENCIES**
Experience gained in operation of the VLF ATD lightning location system N91-32707

**VIBRATION**
Time-frequency domain analysis of helicopter transmission vibration
[ARL-PROP-R-180] N91-32146
US TAG for ISO/TC108 mechanical vibration and shock: Minutes of the accredited standards committee on mechanical shock and vibration, S2
[AD-A239536] N91-32521

**VIBRATION DAMPING**
Integrated mechanics for the passive damping of polymer-matrix composites and composite structures
[NASA-TM-104346] N91-32181
Active damping using a control structure interaction approach N91-32290
Linear mass actuator
[NASA-CASE-LAR-14352-1] N91-32511

**VIBRATION TESTS**
Aeroelastic flutter prevention in gliders and small aircraft
[DLR-MITT-91-03] N91-32142
Qualification status of hybrid crystal oscillators style OTO 16S for space application N91-32322

**VIDEO COMMUNICATION**
Data compression for full motion video transmission
[NASA-TM-105239] N91-32247

**VIDEO DATA**
Data compression for full motion video transmission
[NASA-TM-105239] N91-32247
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601

**VIDEO SIGNALS**
Data compression for full motion video transmission
[NASA-TM-105239] N91-32247

**VISCOPLASTICITY**
Matrix-dominated thermoviscoplasticity in fibrous metal-matrix composite materials N91-32173
Finite element implementation of state variable-based viscoplasticity models
[NASA-CR-187212] N91-32523

**VISCOUS FLOW**
Numerical simulation of unsteady compressible viscous flows using an implicit upwind relaxation scheme N91-32041
Navier-Stokes simulation for complete aircraft configuration N91-32046
Numerical analysis of three-dimensional cascade flow N91-32067
Navier-Stokes computations of three-dimensional turbine cascade flows N91-32068
Solution of perfect gas viscous flows via compressible Navier-Stokes equations with wallslip conditions
[ONERA-RSF-13/3637-AY] N91-32435
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441
Channel flow of a concentrated suspension
[DE91-016649] N91-32453
Numerical study of Stokes flows with suspended particles
[DE91-017011] N91-32455

**VISUAL PERCEPTION**
Contour-map encoding of shape for early vision
[NASA-CR-188937] N91-32545

**VITERBI DECODERS**
Coding gains and error rates from the Big Viterbi Decoder N91-32264
Testing interconnected VLSI circuits in the Big Viterbi Decoder N91-32265

**VOICE COMMUNICATION**
Digitized voice trials N91-32103
Aeronautical Mobile Satellite Service (AMSS) message and voice access request transit delay N91-32107
Operational oceanic air traffic control using satellite data link: Initial implementation N91-32121

**VOICE CONTROL**
Active damping using a control structure interaction approach N91-32290

**VOLCANOES**
International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects
[NASA-CP-3114] N91-32528
Lidar measurements at Garmisch, conversion model, and midlatitude aerosol effects N91-32536
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada
[NASA-CR-183493] N91-32591

**VOLT-AMPERE CHARACTERISTICS**
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551
Performance of a dual anode nickel-hydrogen cell N91-32563

**VOLUME**
Thermodynamics of combustion in an enclosure
[DE91-016430] N91-32992

**VORTEX FILAMENTS**
Analysis of the aerodynamic performance of counter-rotating propeller by means of vortex lattice method N91-32065

**VORTEX RINGS**
Numerical simulation of shock wave emanating from a square shock tube N91-32061

**VORTEX SHEDDING**
Active control of vortex shedding frequency by a splitter plate N91-32059

**VORTEX STREETS**
Active control of vortex shedding frequency by a splitter plate N91-32059

**VORTICES**
Numerical treatment of laminar flow in curved rectangular channels with entrance region N91-32053
Supersonic mixing enhancement by vorticity for high-speed propulsion
[NASA-CR-188920] N91-32079
Compressible flows with vortical disturbances around a cascade of airfoils N91-32083
An experimental investigation of a supersonic vortical flow
[NASA-TM-105102] N91-32085
Numerical simulation of turbulent convection over wavy surfaces
[DLR-FB-91-12] N91-32439
Single vortex motion and elementary pinning force in SNIS Josephson junctions
[DE91-016160] N91-32963

**VORTICITY**
Supersonic mixing enhancement by vorticity for high-speed propulsion
[NASA-CR-188920] N91-32079
Potential vorticity index N91-32672


## W


**WAFERS**
Quantum well, beam deflecting surface emitting lasers
[NASA-CASE-NPO-18243-1-CU] N91-32489
Wafer cost analysis for a soft x ray projection lithography system
[DE91-016605] N91-32918

**WAKES**
Active control of vortex shedding frequency by a splitter plate N91-32059
Excitation of nonlinear wake field in a plasma for particle acceleration
[DE91-017386] N91-32945

**WALL FLOW**
Numerical simulation analysis of sidewall effects in two-dimensional wind tunnels N91-32050
Fully developed mixed convection in a horizontal pipe N91-32057
Wall function method with conservation property N91-32058
Solution of perfect gas viscous flows via compressible Navier-Stokes equations with wallslip conditions
[ONERA-RSF-13/3637-AY] N91-32435
Some current approaches in turbulence modelling N91-32446

**WALL PRESSURE**
Temporal and spectral features of wall pressure fluctuations beneath a turbulent boundary layer N91-32461

**WALLS**
Finite difference numerical prediction of aerodynamics for airfoil flying over wavy wall N91-32043
A k-epsilon modeling of near wall turbulence
[NASA-TM-105238] N91-32460

**WARNING SYSTEMS**
Thunderstorm detection and warning system atmospheric potential monitor N91-32608
Thunderstorm monitoring and lightning warning, operational applications of the Safir system N91-32619
Lightning mapping system N91-32713
Guidelines for a proposed lightning protection policy of a golf association or tournament sponsor N91-32735

**WASHING**
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting
[DE91-017545] N91-32758

**WASTE DISPOSAL**
Leaching behavior of microtektite glass compositions in sea water and the effect of precipitation on glass leaching
[NASA-TM-105106] N91-32225
Transport suction apparatus and absorption materials evaluation N91-32784

**WASTE ENERGY UTILIZATION**
Office of Industrial Technologies research in progress
[DE91-014180] N91-32571
Infrastructure for thulium-170 isotope power systems for autonomous underwater vehicle fleets
[DE91-017464] N91-32911

**WASTE HEAT**
Infrastructure for thulium-170 isotope power systems for autonomous underwater vehicle fleets
[DE91-017464] N91-32911

**WATER**
Space water electrolysis: Space Station through advance missions N91-32553
Modeling water content effects in polymer electrolyte fuel cells
[DE91-016027] N91-32573
Charge transfer during individual collisions in ice growing by riming N91-32727

**WATER COOLED REACTORS**
Benchmark field study of deep neutron penetration
[DE91-015677] N91-32886

**WATER RESOURCES**
Precipitation regime changes associated with climatic changes
[PB91-206656] N91-32740

**WATER VAPOR**
Global water cycle N91-32661
Remote sensing of water vapor features N91-32682
Deriving Earth science products from SSM/I N91-32684
WetNet: Using SSM/I data interactively for global distribution of rainfall and precipitable water N91-32685

**WAVE EQUATIONS**
Compressible flows with vortical disturbances around a cascade of airfoils N91-32083

**WAVE FRONTS**
Zonal deformable mirror for laser wavefront control
[DE91-017085] N91-32483
Feedback controlled optics with wavefront compensation
[NASA-CASE-NPO-18194-1-CU] N91-32924

**WAVE PROPAGATION**
Propagation Limitations for Systems Using Band-Spreading
[AGARD-LS-172] N91-32241
Wide band systems N91-32242
Equivalent circuit model of traveling-wave maser slow-wave structures N91-32256
Resonant triad in boundary-layer stability. Part 1: Fully nonlinear interaction
[NASA-TM-105208] N91-32458
Electromagnetic topology: Characterization of internal electromagnetic coupling N91-32699
Optimal parameters of leader development in lightning N91-32723
Analysis of polarization properties of shallow metallic gratings by an extended Rayleigh-Fano theory
[DE91-016982] N91-32835

**WAVEFORMS**
Performance of a 10 kV, 625 kA, 85 kJ energy discharge module utilizing a solid dielectric switch
[DE91-017432] N91-32409
Current wave-form observed during lightning strikes on aircraft N91-32603
Characteristics of winter lightning currents struck an isolated tower N91-32607
E and DE/DT waveshapes for narrow bipolar pulses in intracloud lightning N91-32610
The performance of cable braids and terminations to lightning induced transients N91-32611
Characteristics of return stroke electric fields produced by lightning flashes at distances of 1 to 15 kilometers N91-32615
Range estimation techniques in single-station thunderstorm warning sensors based upon gated, wideband, magnetic direction finder technology N91-32618
Activation of the Navy's indirect effects lightning simulation laboratory N91-32628
Influence of configuration effects on multiple burst simulation testing N91-32631
A new approach to equipment testing N91-32639
Correlation between some current parameters and optical radiation generated by 280 mm long laboratory sparks N91-32655
Observations of lightning processes using VHF radio interferometry N91-32695
Voltages induced on a power distribution line by overhead cloud lightning N91-32734

**WAVEGUIDE ANTENNAS**
Initial pointing calibrations for the DSS 13 34-meter beam-waveguide antenna N91-32267
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 1: Design and ground tests N91-32269

A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 2: Tests on the antenna N91-32270
Efficiency calibration of the DSS 13 34-meter diameter beam waveguide antenna at 8.45 and 32 GHz N91-32271
DSS 13 phase 2 pedestal room microwave layout N91-32272

**WAVEGUIDES**
Initial testing of a two-dimensional computer code for microwave-induced surface breakdown in air [DE91-015763] N91-32286
The United Kingdom waveguide power standards above 40 GHz [NPL-DES-105] N91-32395

**WAVELENGTHS**
Analysis of polarization properties of shallow metallic gratings by an extended Rayleigh-Fano theory [DE91-016982] N91-32835

**WEAK INTERACTIONS (FIELD THEORY)**
Research program in elementary particle theory (task A) [DE91-016937] N91-32895

**WEAPON SYSTEMS**
WASP, the Weapon Analysis and Simulation Program [FEL-90-A322] N91-32813

**WEAR**
Spectroscopic wear detector [NASA-CASE-LEW-15200-1] N91-32167
Lubrication with sputtered MoS2 films: Principles, operation, limitations [NASA-TM-105292] N91-32216
Corrosion and arc erosion in MHD channels [DE91-016829] N91-32939

**WEATHER**
Report of the expert group on global baseline datasets [WCDP-11] N91-32598
Assessment and forecasting of lightning potential and its effect on launch operations at Cape Canaveral Air Force Station and John F. Kennedy Space Center N91-32704
Severe thunderstorm cases of July 1989 thru June 1990 [PB91-201392] N91-32738
Parallel scalability of the spectral transform method [DE91-017991] N91-32744

**WEATHER FORECASTING**
Thunderstorm detection and warning system atmospheric potential monitor N91-32608
Predicting cloud-to-ground lightning with neural networks N91-32646
NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review [NASA-CP-3126] N91-32660
MAMS: High resolution atmospheric moisture/surface properties N91-32664
Electrification in winter storms and the analysis of thunderstorm overflight N91-32678
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 2 [NASA-CP-3106-VOL-2] N91-32693
Surface wind convergence as a short-term predictor of cloud-to-ground lightning at Kennedy Space Center: A four-year summary and evaluation N91-32703
Assessment and forecasting of lightning potential and its effect on launch operations at Cape Canaveral Air Force Station and John F. Kennedy Space Center N91-32704
Severe thunderstorm cases of July 1989 thru June 1990 [PB91-201392] N91-32738
UJNR Tsunami Workshop Proceedings [PB91-193656] N91-32747

**WEBS (SUPPORTS)**
Lightning protection design and testing of an all composite wet wing for the Egrett N91-32642

**WEIGHT REDUCTION**
Microwave blind mate coaxial connectors N91-32317
Regenerative fuel cell architectures for lunar surface power N91-32560

**WEIGHTLESSNESS**
Space sickness N91-32764
Application and use of spinal immobilization devices in zero-gravity flight N91-32781
Evaluation of aerosolized medications during parabolic flight maneuvers N91-32783
Transport suction apparatus and absorption materials evaluation N91-32784
Shuttle Orbiter medical system equipment/supplies evaluation N91-32793

**WEIGHTLESSNESS SIMULATION**
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals N91-32785
Minor surgery in microgravity N91-32786
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) N91-32787
Venipuncture and intravenous infusion access during zero-gravity flight N91-32788

**WELD TESTS**
High speed welding used in building metallic structures [CRIF-MT-180] N91-32496
Gas tungsten arc adaptive welding [DE91-017848] N91-32513

**WELDED JOINTS**
High speed welding used in building metallic structures [CRIF-MT-180] N91-32496
Numerical simulation of a laser welding process [DE91-016454] N91-32500

**WELDED STRUCTURES**
High speed welding used in building metallic structures [CRIF-MT-180] N91-32496

**WEST GERMANY**
Experiences with components in the DFS-project: Seen from a customer's point of view N91-32366

**WETTING**
Fundamental metallurgical considerations in brazing and soldering [DE91-016224] N91-32209

**WHISKER COMPOSITES**
Tensile and cyclic fatigue pruperties of SiC whisker-reinforced Al2O3 [DE91-015916] N91-32179

**WHISKERS (CRYSTALS)**
Tensile and cyclic fatigue properties of SiC whisker-reinforced Al2O3 [DE91-015916] N91-32179

**WHITE NOISE**
Coding gains and error rates from the Big Viterbi Decoder N91-32264

**WIDEBAND COMMUNICATION**
HF systems operating beneath the ionosphere N91-32244

**WIGGLER MAGNETS**
Small signal gain for parabolic profile beams in free electron lasers [DE91-016236] N91-32478
Coherent-state description of free-electron lasers [DE91-017077] N91-32486

**WIND (METEOROLOGY)**
Wind energy potential in the United States considering environmental and land-use exclusions [DE91-017535] N91-32577
Research on diabatic initialization N91-32671
Beta measurements N91-32681
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida [DE91-017445] N91-32743

**WIND DIRECTION**
Deriving Earth science products from SSM/I N91-32684

**WIND EFFECTS**
Near ground sound propagation in wind [CSTB-2-89-003-4] N91-32871

**WIND MEASUREMENT**
Uncertainty analysis of a radome flush orifice air motion system for the measurement of aircraft incident angles [PB91-198176] N91-32133
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686

**WIND PROFILES**
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686

**WIND TUNNEL APPARATUS**
Nozzle diffuser for use with an open test section of a wind tunnel [NASA-CASE-LAR-14424-1-SB] N91-32149

**WIND TUNNEL TESTS**
Numerical simulation analysis of sidewall effects in two-dimensional wind tunnels N91-32050
Determination of aerodynamic characteristics from ATTAS flight data gathering for ground-based simulator [DLR-FB-91-15] N91-32076
A laser velocimeter investigation of the normal shock-wave boundary layer interaction [NASA-TM-105201] N91-32440

**WIND TUNNEL WALLS**
Numerical simulation analysis of sidewall effects in two-dimensional wind tunnels N91-32050

**WIND TUNNELS**
Rarefied gas numerical wind tunnel 6: Delta wing N91-32039
Numerical simulation analysis of sidewall effects in two-dimensional wind tunnels N91-32050
Nozzle diffuser for use with an open test section of a wind tunnel [NASA-CASE-LAR-14424-1-SB] N91-32149
Fluid dynamics of double diffusive systems [DE91-017401] N91-32465

**WIND TURBINES**
Wind energy potential in the United States considering environmental and land-use exclusions [DE91-017535] N91-32577

**WIND VELOCITY**
Deriving Earth science products from SSM/I N91-32684
Surface wind convergence as a short-term predictor of cloud-to-ground lightning at Kennedy Space Center: A four-year summary and evaluation N91-32703

**WINDPOWER UTILIZATION**
Wind energy potential in the United States considering environmental and land-use exclusions [DE91-017535] N91-32577
Evaluation of the damages caused by lightning current flowing through bearings N91-32632

**WING PROFILES**
Turbulence modelling: Survey of activities in Belgium and The Netherlands, an appraisal of the status and a view on the prospects N91-32444

**WING TANKS**
Lightning protection design and testing of an all composite wet wing for the Egrett N91-32642

**WING TIP VORTICES**
Analysis of the aerodynamic performance of counter-rotating propeller by means of vortex lattice method N91-32065

**WINGS**
Aerodynamic design of non-planar wing by inverse method with Navier-Stokes equation N91-32045
The three dimensional Navier-Stokes simulations of flow over a wing without any turbulent modelling N91-32051
Protection of electrical and electronic equipment against lightning indirect effects on the Airbus A340 wing N91-32613
An assessment of tailoring of lightning protection design requirements for a composite wing structure on a metallic aircraft N91-32641
Lightning protection design and testing of an all composite wet wing for the Egrett N91-32642

**WINTER**
Aerosol sensing from balloons using photopolarimetry N91-32538
Characteristics of winter lightning currents struck an isolated tower N91-32607
Potential vorticity index N91-32672
Electrification in winter storms and the analysis of thunderstorm overflight N91-32678

**WIRE WINDING**
Stress states in wound capacitors [DE91-016402] N91-32400

**WIRING**
High performance packages for space applications N91-32311
The performance of cable braids and terminations to lightning induced transients N91-32611
Protection of electrical and electronic equipment against lightning indirect effects on the Airbus A340 wing N91-32613
Lightning induced currents in aircraft wiring using low level injection techniques N91-32694

**WORKING FLUIDS**
Materials compatibility issues for fabric composite radiators [DE91-017556] N91-32186

**WORKSTATIONS**
Workshop on NASA workstation technology [NASA-CR-188866] N91-32800

## X

**X RAY ABSORPTION**
X ray absorption fine structure of systems in the anharmonic limit [DE91-016070] N91-32892

**X RAY ANALYSIS**
High-energy synchrotron radiation x ray microscopy: Present status and future prospects [DE91-016894] N91-32893

**X RAY APPARATUS**
Distortion free projection lithography [DE91-016570] N91-32916
Wafer cost analysis for a soft x ray projection lithography system [DE91-016605] N91-32918

**X RAY ASTRONOMY**
High energy from space N91-33023

**X RAY LASERS**
Future directions of laboratory x ray laser research
[DE91-017088] N91-32487
**X RAY SCATTERING**
Soft x ray magnetic scattering study of thin films and multilayers
[DE91-017472] N91-32920
**X RAY SOURCES**
Ion clearing and photoelectron production in the 200 MeV SXLS ring
[DE91-017156] N91-32907
Coherent hard x ray focusing optics and applications
[DE91-017968] N91-32928
**X RAY SPECTROSCOPY**
Further proton damage effects in EEV CCDs
N91-32340
**X RAYS**
Comparison of factors given in ICRU report 23 and IAEA TRS 277 for converting from exposure/air kerma to absorbed dose to water for medium energy x rays
[NPL-RSA(EXT)-15] N91-32147
High-energy synchrotron radiation x ray microscopy: Present status and future prospects
[DE91-016894] N91-32893
Circular Intensity Differential Scattering (CIDS) measurements in the soft x ray region of the spectrum (approximately 16 eV to 500 eV)
[DE91-016429] N91-32915

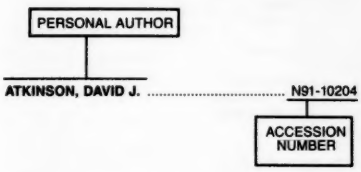
## Y

**YTTRIUM OXIDES**
De Haas van Alphen effect in high temperature superconductors
[DE91-016198] N91-32397
Neutron diffraction by the flux lattice in high-Tc superconductors
[DE91-017866] N91-32418
Neutron scattering from the flux lattice in high temperature superconductors
[DE91-017947] N91-32419
Critical currents in melt-textured YBa2Cu3O(x)
[DE91-016523] N91-32966
Evidence for cation disorder in in-situ grown YBaCuO superconducting films
[DE91-016760] N91-32971
Fermi surface measurements in YBa2Cu3O(7-x) and La(1.874)Sr(126)CuO4
[DE91-017094] N91-32973
Anisotropy in the a-b plane of normal and superconducting YBa2Cu3O(x)
[DE91-017997] N91-32989

## Z

**ZENITH**
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 2: Tests on the antenna N91-32270
**ZINC**
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application
[NASA-TM-103551] N91-32217
Shock-vaporization studies on zinc and porous carbon
[DE91-017846] N91-32233
**ZINC OXIDES**
Reaction sintering of ZnO-Al2O3
[DE91-016254] N91-32210
**ZIRCONIUM OXIDES**
Heat transfer effectiveness of a thermal barrier coating with different fuel compositions
[DE91-015602] N91-32222
Ceramic coatings on smooth surfaces
[NASA-CASE-LEW-15164-2] N91-32229
**ZONAL FLOW (METEOROLOGY)**
Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere
N91-32673
Research highlights: June 1990 - May 1991
N91-32676

### Typical Personal Author Index Listing




Listings in this index are arranged alphabetically by personal author. The accession number denotes the number by which the citation is identified.

## A


ABBEY, A. N91-32340
ABE, AKIHISA N91-32061
ABELL, J. S. N91-32418
ABT, HELMUT A. N91-33031
ACTON, LOREN W. N91-33029
ADAMS, L. N91-32292
ADDIS, R. B. N91-32501
AGBORMBAI, ADOLF A. N91-32425
AHEARN, MICHAEL F. N91-33020
N91-33027
AHLERS, C. N91-32984
AHN, B. T. N91-32958
AHRENS, E. T. N91-32959
AJAYI, O. O. N91-32505
AKBARI, H. N91-32586
AKIMOTO, TOSHIO N91-32034
AKIYAMA, T. N91-32936
ALAM, M. S. N91-32239
ALBRECHT, PETER N91-32999
ALBRIGHT, K. N91-32407
ALCOCK, CHARLES N91-33025
ALESSO, P. N91-32503
ALEXANDER, D. E. N91-32981
ALIOD, R. N91-32448
ALLAMANDOLA, LOU N91-33025
ALLEN, BRADLEY P. N91-32837
ALLEN, D. C. N91-32502
ALLENDORF, S. W. N91-32885
ALLIOT, J. C. N91-32637
N91-32648
ALP, E. E. N91-32974
ALTON, G. D. N91-32899
ALVAREZ, L. S. N91-32267
N91-32271
AMANO, KANICHI N91-32050
ANDERSEN, J. N91-32314
ANDERSON, TERESA A. N91-32103
ANDERSON, W. J. N91-32389
ANDO, SHIGENORI N91-32043
ANDO, T. N91-32218
ANDREWS, CHRISTOPHER J. N91-32621
N91-32622
ANDREWS, CHRISTOPHER N. N91-32119
ANDRISI, JEAN-PAUL N91-32384
ANGEL, J. ROGER N91-33020
N91-33021
ANSHER, J. A. N91-33043
ANTIOCHOS, SPIRO K. N91-33026
AOYAMA, TAKASHI N91-32066
APARICIO, J. P. N91-32699
APPELBAUM, JOSEPH N91-33046
APPLEBY, A. JOHN N91-32558
APRILE, ELENA N91-33024
ARAI, NORIO N91-32059
ARBEL, D. N91-32258
ARIMA, IZUMI N91-32647
ARIYAWANSA, K. A. N91-32833
ARKO, A. J. N91-32878
ARMANTROUT, G. A. N91-32502
ARMSTRONG, DONALD N91-32121
ARNETT, DAVID W. N91-33028
ARNOLD, G. W. N91-32977
ARTUPHEL, FREDERIC N91-32384
ASLAN, R. N91-32434
ATHERTON, C. S. N91-32588
ATKINSON, ROBERT J. N91-32664
ATTIA, A. I. N91-32566
N91-32567
AUGIER, P. N91-32341
AVILA, ELDO E. N91-32727
AXELROD, T. S. N91-32544


## B


BACKER, DONALD C. N91-33018
BACKES, PAUL G. N91-32509
N91-32510
BAER, H. W. N91-32901
BAGUENA, L. N91-32300
BAHCALL, JOHN N. N91-33017
N91-33030
BAHCALL, NETA A. N91-33029
BAIER, PAUL WALTER N91-32242
BAILEY, J. E. N91-32908
N91-32942
BAILEY, JAMES W. N91-32196
BAILEY, WILLIAM J. N91-32166
BAKTASH, C. N91-32899
BALACHANDRAN, A. P. N91-32895
BALDWIN, G. T. N91-32942
BALDWIN, R. N91-32562
BALDWIN, R. E. N91-32705
BALL, D. G. N91-32413
N91-32482
BALLY, JOHN N91-33019
BALOOCH, M. N91-32917
BALSARA, DINSHAW S. N91-33050
BAMBERGER, J. A. N91-32169
BANKSTON, NATHANIEL G. N91-32604
BARBER, Z. H. N91-32987
BARBOUR, J. C. N91-32962
BARCILON, ALBERT N91-32672
BARISH, BARRY C. N91-33024
BARKER, D. L. N91-32623
BARKER, J. J. N91-32990
BARLETT, R. J. N91-32878
BARNA, P. STEPHEN N91-32149
BARNES, ARNOLD A., JR. N91-32645
N91-32646
BARNES, C. N91-32331
BARNEY, DANIEL L. N91-32374
BARR, S. M. N91-33041
BARRE, M. N91-32383
N91-32386
BARRET, L. N91-32649
BARRETT, D. M. N91-32402
BARRETT, J. N91-32328
BARRY, A. L. N91-32337
BARTAK, F. N91-32073
BARTELS, J. R. N91-32499
BARTINE, D. E. N91-32150
BASTIAN, R. D. N91-32193
BATINA, JOHN T. N91-32084
BATISTIC, I. N91-32892
BATTRICK, BRUCE N91-32152
BAUCHAU, OLIVIER A. N91-32519
BAUDUIN, B. N91-32307
BAUER, WENDY HAGEN N91-33031
BAUTISTA, J. J. N91-32255
BAZAN, G. N91-33038
N91-33039
BEASLEY, K. N91-32311
BEASLEY, M. R. N91-32971
BECHER, P. F. N91-32228
BECHTLE, PERRY N91-32788
BECKER, K. N91-32583
BECKLIN, ERIC N91-33019
BECKWITH, STEVEN V. W. N91-33020
BEEKMAN, DOUGLAS H. N91-32166
BEGELMAN, MITCHELL C. N91-33022
BEGIS, D. N91-32073
BEHM, C. J. N91-32281
BEHUN, VAUGHN D. N91-32511
BEICHMAN, CHARLES A. N91-33017
N91-33031
BEIER, EUGENE W. N91-33024
BEJCZY, ANTA K. N91-32805
BELCHER, JEWELL G., JR. N91-32795
BELIAN, R. D. N91-33049
BELL, WAYNE N91-32283
BELLE, STEVEN D. N91-32850
BELTON, MICHAEL J. S. N91-33027
BEMENT, LAURENCE J. N91-32196
BENAMOR, S. N91-32300
BENDER, PETER N91-33022
BENDER, S. C. N91-32484
BENN, DOUGLAS FRANK N91-33003
BENSOUSSAN, A. N91-32303
N91-32312
BENT, RODNEY B. N91-32706
BENZ, DARREN N91-32785
BERGUM, J. W. N91-32483
BERKOWITZ, JACK N91-32126
BERLYAND, V. A. N91-32874
BERMAN, E. N91-33032
BERRY, B. F. N91-32873
BERRY, V. B. N91-32387
BERRYMAN, J. G. N91-32473
BERTHEL, ROBERT O. N91-32645
BEVAN, R. N91-32260
BEWLEY, DOUGLAS P. N91-32163
BEYERS, R. N91-32958
BEYNE, E. N91-32310
BIEFELD, R. M. N91-32976
BILLICA, ROGER N91-32777
N91-32778
N91-32781
N91-32786
N91-32788
N91-32789
N91-32790
N91-32791
BILLINGS, CHARLES E. N91-32135
BION, T. N91-32349
BIRD, S. A. N91-32351
BIRINGER, K. L. N91-32150
BIRX, D. L. N91-32482
BISHOP, A. R. N91-32892
BISHOP, JAMES N91-33042
BISHOP, PETER C. N91-32824
BISHOP, WALTON BURRELL N91-32771
BITTNER, BURT J. N91-32730
BJORKEN, J. D. N91-32883
BLACK, DAVID N91-33027
BLAES, B. R. N91-32327
BLAKESLEE, RICHARD N91-32667
N91-32720
BLANCHART, J. N91-32385
BLANDFORD, ROGER D. N91-33021
BLATTER, GIANNI N91-32988
BLESS, ROBERT C. N91-33029
BLESS, ROBERT RICHARD, JR. N91-32156
BLINN, THOMAS M. N91-32803
N91-32804
BLISS, E. S. N91-32483
BLOOMQUIST, D. D. N91-32942
BOBIN, G. N91-32305
BODEN, A. N91-32354
N91-32355
BOECK, WILLIAM L. N91-32720
BOEMAN, RAYMOND G. N91-32172
BOGGESS, ALBERT N91-33021
BONDIOU, A. N91-32620
BOOTHROYD, A. T. N91-32902
BORZILERI, C. V. N91-32238
BOSTIC, SUSAN W. N91-32526
BOTTCHER, C. N91-32867
N91-32884
BOTTS, MIKE N91-32669
BOUDENOT, J. C. N91-32341
BOULAY, J. L. N91-32603
N91-32650
BOURRIEAU, J. N91-32349
BOUTON, F. N91-32326
BOVERIE, B. N91-32289

BOWDLE, D. A. ..... N91-32666
BOWLIN, LONNIE H. ..... N91-32094
BOWYER, C. STUART ..... N91-33021
BOYCE, JOEY B. ..... N91-32781
N91-32788
BOYCE, PETER B. ..... N91-33031
BOZOKI, E. ..... N91-32907
BOZZOLO, GUILLERMO ..... N91-32204
N91-32215
BRADELY, R. S. ..... N91-32742
BRADSHAW, PETER ..... N91-32451
BRAEUNIG, D. ..... N91-32337
N91-32338
N91-32354
N91-32355
BRANDENBERGER, ROBERT ..... N91-33024
BRANUM, J. D. ..... N91-32482
BRAUN, A. T. ..... N91-32239
BRECKENRIDGE, WILLIAM C. ..... N91-32924
BREEDING, TIFFANY ..... N91-32793
BREGADZE, J. I. ..... N91-32874
BREIZMAN, B. N. ..... N91-32945
BRENNAN, A. M. ..... N91-32747
BRICKNER, R. G. ..... N91-32863
BRIERE, M. A. ..... N91-32337
N91-32338
BRIET, M. ..... N91-32334
BRIET, R. ..... N91-32623
BRINDLEY, W. J. ..... N91-32229
BRINK, NORMAN O. ..... N91-32177
BRINKMAN, C. R. ..... N91-32179
BRITCLIFFE, M. J. ..... N91-32271
BROCKENBROUGH, JOHN ROGER ..... N91-32516
BROCKMAN, M. H. ..... N91-32273
BROOK, MARX ..... N91-32678
N91-32720
BROWN, A. M. ..... N91-32231
BROWN, CHRISTOPHER WILLIAM ..... N91-32498
BROWN, D. R. ..... N91-32576
BROWN, EDWARD N. ..... N91-32133
BROWN, G. E. ..... N91-32892
BROWN, R. L. ..... N91-32846
BROWN, ROBERT A. ..... N91-33027
N91-33029
BROWN, ROBERT HAMILTON ..... N91-33019
N91-33027
BROWN, ROBERT L. ..... N91-32800
BROWN, S. ..... N91-32248
BRUEMMER, S. M. ..... N91-32212
BRUGUIER, G. ..... N91-32363
N91-32364
BRUMBAUGH, RANDAL W. ..... N91-32850
N91-32851
BRUNET, JEAN-PIERRE ..... N91-32356
N91-32359
BRYDON, G. M. ..... N91-32303
N91-32380
BUCHANAN, H. R. ..... N91-32279
BUCHHEIT, R. G., JR. ..... N91-32219
BUDEN, D. ..... N91-32150
BUDHANI, R. ..... N91-32972
BUDURKA, WILLIAM J. ..... N91-32098
BUECHLER, DENNIS ..... N91-32667
BUEHLER, M. G. ..... N91-32327
BUEKER, RICHARD ..... N91-32785
BUISSON, J. ..... N91-32356
BUISSON, JACQUES ..... N91-32359
BUITEVELD, H. ..... N91-32469
BUMA, MARC ..... N91-32468
BURBIDGE, GEOFFREY ..... N91-33029
N91-33031
BURGER, A. ..... N91-32983
BURKE, BERNARD F. ..... N91-33022
N91-33029
BURKE, W. R. ..... N91-32597
BURMESTER, C. P. ..... N91-32958
BURNS, J. E. ..... N91-32874
BURROWS, B. J. C. ..... N91-32639
N91-32642
N91-32716
BURROWS, K. ..... N91-32314
BURTON, D. E. ..... N91-32457
N91-32467
BUSTAMANTE, C. ..... N91-32915
BUTLER, GEOFF ..... N91-32850
BUTLER, K. A. ..... N91-32662
BUXTON, S. D. ..... N91-32745
BYRD, D. A. ..... N91-32484
BYRNE, R. H. ..... N91-32858

## C

CABRERA, BLAS ..... N91-33024
CADWELL, K. L. ..... N91-32980
CAHAN, BORIS D. ..... N91-32559
CALDWELL, DAVID ..... N91-33024
CALVEL, P. ..... N91-32363
CALVERT, L. D. ..... N91-32208
CAMERON, ALASTAIR G. W. ..... N91-33028
CAMPBELL, J. H. ..... N91-32227
N91-32985
CANFIELD, P. C. ..... N91-32878
N91-32959
CANFIELD, RICHARD C. ..... N91-33026
CANIZARES, CLAUDE ..... N91-33017
N91-33023
CANNELL, D. S. ..... N91-32984
CANNON, T. ..... N91-33002
CANTALOUBE, M. ..... N91-32631
CARANTI, GIORGIO M. ..... N91-32727
CARDEN, JAMES R. ..... N91-32795
CARLSON, A. L. ..... N91-32908
N91-32942
CARLSON, GRANT S. ..... N91-32664
CARNEY, BRUCE W. ..... N91-33020
CAROFF, L. J. ..... N91-33033
CARPENTER, ROY B., JR. ..... N91-32731
CARRUTHERS, GEORGE R. ..... N91-33021
CASANOVA, EDGAR J. ..... N91-32515
CASPER, PAUL W. ..... N91-32706
CASSIDAY, GEORGE ..... N91-33024
CASTEL, M. ..... N91-32363
CASTRO-RODRIGUEZ, FRANCISCO ..... N91-32096
CATURA, RICHARD C. ..... N91-33023
CAYTON, T. E. ..... N91-33049
CEGLIO, N. M. ..... N91-32916
N91-32918
CELI, O. ..... N91-32632
CHABANNES, PATRICE L. ..... N91-32359
CHAI, B. H. T. ..... N91-32481
CHAI, J. C. ..... N91-32623
CHAISSON, ERIC ..... N91-33030
CHALLINOR, GRAEME ..... N91-32101
CHAMIS, CHRISTOS C. ..... N91-32181
N91-32182
N91-32520
CHAN, TONY F. ..... N91-32845
CHANDLER, G. ..... N91-32942
CHANG, B. ..... N91-32898
CHANG, GEORGE C. ..... N91-32122
CHANG, T. Y. P. ..... N91-32523
CHANTREL, J. M. ..... N91-32073
CHAO, GAO ..... N91-32709
CHAO, K. ..... N91-32315
CHAO, TIEN-HSIN ..... N91-32925
CHAPUIS, T. ..... N91-32345
N91-32348
N91-32356
CHARIG, R. J. ..... N91-32353
CHARLES, J. P. ..... N91-32363
CHARLOT, L. A. ..... N91-32212
CHASE, L. L. ..... N91-32481
CHAUHAN, D. S. ..... N91-32512
CHAUZY, SERGE ..... N91-32653
CHEATWOOD, F. MCNEIL ..... N91-32441
CHEBOTAEV, P. Z. ..... N91-32945
CHEESEMAN, PETER ..... N91-32816
CHEN, J. C. ..... N91-32272
CHEN, J. G. ..... N91-32966
CHEN, Y. G. ..... N91-32633
CHENEVEY, MICHAEL J. ..... N91-32591
CHENG, C. C. ..... N91-32505
CHENG, E. T. ..... N91-32952
CHEONG, S-W. ..... N91-32959
CHERNOV, E. N. ..... N91-32729
CHESSUM, C. ..... N91-32642
CHEUNG, K.-M. ..... N91-32266
CHEVALIER, ROGER A. ..... N91-33025
CHILDERS, RICHARD ..... N91-32732
CHISHOLM, J. D. ..... N91-32140
CHOU, S.-H. ..... N91-32662
CHOU, T. S. ..... N91-32211
CHOUDHURY, A. ..... N91-32960
CHOW, TZE-SHOW ..... N91-32503
CHRISS, RANDALL M. ..... N91-32440
CHRISTENSEN, R. A. ..... N91-33049
CHRISTIAN, HUGH ..... N91-32667
CHRISTY, JOHN R. ..... N91-32661
N91-32663
N91-32683
N91-32689
CHRZAS, J. ..... N91-32928
CHUANG, CHUN-HUA ..... N91-32230
CHUANG, S. S. C. ..... N91-32192
CHUNG, CHING LUAN ..... N91-32494
CHUPP, EDWARD L. ..... N91-33026
CIRONE, R. ..... N91-32321
CLAEYS, C. ..... N91-32296
CLARK, GEORGE W. ..... N91-33023
N91-33029
CLARK, JOHN H. E. ..... N91-32674
CLARK, O. MELVILLE ..... N91-32624
CLARK, WILLIAM S. ..... N91-32442
CLAYTON, D. C. ..... N91-33012
CLINE, DAVID B. ..... N91-33024
N91-33025
CLINTHORNE, JAMES T. ..... N91-32088
CLOSE, F. E. ..... N91-32877
COBLEY, GEORGE A. ..... N91-32105
COCHRAN, ANITA L. ..... N91-33027
N91-33031
CODE, ARTHUR ..... N91-33030
COEL, V. ..... N91-32620
COFFEY, HELEN E. ..... N91-33047
N91-33048
COHEN, G. C. ..... N91-32853
COHEN, GERALD C. ..... N91-32132
COHEN, MARSHALL H. ..... N91-33018
COIC, Y. M. ..... N91-32346
COLBERG, AMADO ..... N91-32118
COLE, R. L. ..... N91-32506
COLLIER, RICHARD S. ..... N91-32733
COLQUHOUN, DAVID M. ..... N91-32621
COLUMBUS, RICHARD L. ..... N91-32792
COLVIN, M. E. ..... N91-32544
CONDIT, R. ..... N91-32503
CONKLIN, EDWARD K. ..... N91-33030
CONKLIN, J. C. ..... N91-32991
CONLON, R. F. B. ..... N91-32303
CONRADSON, S. D. ..... N91-32892
CONSTANS, H. ..... N91-32345
CONTI, PETER S. ..... N91-33020
COOK, D. M. ..... N91-32715
COOK, E. G. ..... N91-32482
COOK, WILLIAM D. ..... N91-32565
COOPER, G. ..... N91-32942
COORAY, VERNON ..... N91-32655
N91-32657
N91-32658
CORBIERE, T. ..... N91-32334
CORBIN, JAMES E. ..... N91-32993
CORBIN, MALCOLM ..... N91-32850
CORDOVA, FRANCE A. ..... N91-33029
CORNILSEN, B. C. ..... N91-32556
CORNWELL, TIM ..... N91-33022
COS, S. ..... N91-32296
COSS, J. ..... N91-32331
COULURIS, GEORGE J. ..... N91-32123
COUSTEIX, J. ..... N91-32445
COVAL, P. ..... N91-32312
COWAN, J. J. ..... N91-33038
COWAN, JOHN ..... N91-33030
COWIE, LENNOX L. ..... N91-33021
CRABTREE, G. W. ..... N91-32967
N91-32968
N91-32969
N91-32989
CRAM, D. J. ..... N91-32205
CRARY, DAVID JAMES ..... N91-33035
CRAVEN, JEFFERY D. ..... N91-32725
CRAVEY, W. R. ..... N91-32409
CREAGER, GERALD J. ..... N91-32788
CREVEL, P. ..... N91-32334
N91-32335
CRIMMINS, JOHN H., JR. ..... N91-32109
CRIST, C. E. ..... N91-32942
CROFTS, DAVID ..... N91-32611
N91-32643
CROI, WILLIBALD ..... N91-32542
CRONIN, JAMES ..... N91-33017
N91-33024
CROOK, ANDREW J. ..... N91-32138
CROSS, JON ..... N91-32947
CROSSLAND, P. ..... N91-32424
CROSSLEY, EDWARD A. ..... N91-32511
CROWTHER, H. G. ..... N91-32738
CRUIKSHANK, DALE P. ..... N91-33027
CRUTCHER, RICHARD M. ..... N91-33028
CUBITT, R. ..... N91-32418
N91-32419
CUMMINS, KENNETH L. ..... N91-32618
CUNNINGHAM, G. ..... N91-32317
CUNY, P. ..... N91-32383
N91-32386
CUTTEN, D. ..... N91-32666
CWIK, T. ..... N91-32272

## D

DAGLE, J. E. ..... N91-32168
N91-32408
DAIGUJI, HISAAKI ..... N91-32063
DALGARNO, ALEXANDER ..... N91-33025
N91-33030
DANG, K. ..... N91-32438
DANGTRAN, K. ..... N91-32437

DANIELS, J. I. ..... N91-32758
DARGI, M. ..... N91-32717
N91-32718
DARNEY, I. ..... N91-32639
DARVENIZA, MAT ..... N91-32621
N91-32622
DAVENPORT, RONALD J. ..... N91-32553
DAVID, G. ..... N91-32324
DAVIDSON, J. A. ..... N91-33033
DAVIES, C. E. ..... N91-32987
DAVIES, K. T. R. ..... N91-32869
DAVIS, C. CALVIN ..... N91-32511
DAVIS, MICHAEL ..... N91-33018
DAVIS, S. ..... N91-32586
DAWSON, L. R. ..... N91-32976
DAYSH, COLIN ..... N91-32850
DEAN, D. J. ..... N91-32881
DECEUNINCK, W. ..... N91-32310
DECLERCK, G. ..... N91-32296
DECONINCK, HERMAN ..... N91-32429
N91-32430
DEHEL, THOMAS F. ..... N91-32107
DEHOFF, P. H. ..... N91-32512
DEJARNETTE, FRED R. ..... N91-32441
DEJONGHE, L. C. ..... N91-32404
DELANEY, ROBERT A. ..... N91-32138
DELCASTILLO, D. ..... N91-32464
DELIGIANNIS, F. ..... N91-32567
DELUCA, CLYDE C. ..... N91-32796
DELUCA, P. M., JR. ..... N91-32894
DEMING, DRAKE ..... N93-30026
DEMINICO, G. A. ..... N91-32501
DENNING, PETER J. ..... N91-32815
N91-32817
N91-32819
N91-32822
DEPATER, IMKE ..... N91-33018
N91-33027
DEREUS, N. M. ..... N91-32813
DERSZON, M. S. ..... N91-32942
DERWENT, R. ..... N91-32583
DESCHEPPER, L. ..... N91-32310
DESHLER, TERRY ..... N91-32534
DESTEESE, J. G. ..... N91-32408
DETAVERNIER, S. ..... N91-32193
DEVILLER, J. L. ..... N91-32322
DEVLIEGER, J. H. ..... N91-32862
DEVOLDERE, P. ..... N91-32307
DEWAGENAERE, PH. ..... N91-32073
DEYOUNG, DAVID ..... N91-33018
DIALLO, B. S. ..... N91-32538
DIAZ, H. F. ..... N91-32742
DIAZDELARUBIA, T. ..... N91-32979
DICKINSON, I. P. ..... N91-32808
DIENDORFER, GERHARD ..... N91-32736
DIERICKX, B. ..... N91-32296
DIEZDEFRUTOS, A. ..... N91-32320
DIGNON, J. ..... N91-32588
DIMARCANTONIO, U. ..... N91-32321
DIMEO, HILDA M. ..... N91-32282
DIMOCK, NORMAN F. ..... N91-32104
DIVECHA, AMARNATH P. ..... N91-32224
DOARN, CHARLES R. ..... N91-32776
DODD, A. C. ..... N91-32376
DOEFF, M. M. ..... N91-32404
DOHAN, Y. ..... N91-32319
DOMINGO, N. ..... N91-32222
DONGARRA, JACK J. ..... N91-32844
DOPAZO, C. ..... N91-32448
DORFLER, JOSEPH F. ..... N91-32095
DORFMAN, ROBERT ..... N91-33031
DOSCHEK, GEORGE A. ..... N91-33021
N91-33026
DOWELL, D. H. ..... N91-32484
DOWLING, D. T. ..... N91-32899
DOWNEY, J. ..... N91-32967
N91-32968
N91-32989
DOYLE, B. L. ..... N91-32976
DRAINE, BRUCE ..... N91-33019
DRAKE, FRANK ..... N91-33030
DRAKE, J. B. ..... N91-32456
DRAPER, JAMES STARK ..... N91-32646
DREIFUERST, G. R. ..... N91-32401
DREVER, RONALD ..... N91-33022
DRUCE, R. L. ..... N91-32415
DUBELAAR, G. B. J. ..... N91-32469
DUBROFF, W. ..... N91-32218
DUCROCQ, J. B. ..... N91-32330
DUDENHOEFER, JAMES E. ..... N91-32569
DUESING, A. ..... N91-32189
DUFFY, M. K. ..... N91-32860
DUFOUR, C. ..... N91-32348
DUKE, E. L. ..... N91-32851
DUKE, EUGENE L. ..... N91-32850
DULK, GEORGE A. ..... N91-33018
N91-33026
DUMAS, J. M. ..... N91-32304
DUNKLEY, V. P. ..... N91-32639
N91-32642
DUPREE, ANDREA K. ..... N91-33021
DUSAUTOY, A. R. ..... N91-32874
DUVAL, RONALD W. ..... N91-32071
DUZELLIER, S. ..... N91-32348
DYCK, H. MELVIN ..... N91-33022

## E

EARL, M. W. ..... N91-32555
EARLEY, L. M. ..... N91-32403
EBEL, A. ..... N91-32583
EBERHARDT, SILVIO P. ..... N91-32852
EBISUZAKI, WESLEY ..... N91-32687
ECOFFET, R. M. ..... N91-32298
N91-32361
ED-DAHABI, K. ..... N91-32364
EDWARDS, BERNELL J. ..... N91-32773
EDWARDS, SUZAN ..... N91-33020
EECKMAN, F. H. ..... N91-32544
EHLERT, DIETER ..... N91-32548
EHRHARDT, HARDY ..... N91-32543
EISSFELDT, HINNERK ..... N91-32090
EKSHTUT, A. ..... N91-32504
ELDER, M. L. ..... N91-32227
N91-32985
ELEY, H. E. ..... N91-32623
ELLIOTT, C. J. ..... N91-32478
ELLIOTT, D. L. ..... N91-32577
ELMEGREEN, BRUCE G. ..... N91-33025
ELSAYED-ALI, H. E. ..... N91-32206
N91-32207
ELSON, REBECCA ..... N91-33030
EMANUELY, J. L. ..... N91-32631
ENGHOLM, C. ..... N91-32620
ENGLISH, ROBERT E. ..... N91-32165
ERCK, R. A. ..... N91-32505
ERDEMIR, A. ..... N91-32505
ERICKSON, E. F. ..... N91-33033
ERIKSEN, FREDERICK J. ..... N91-32656
ERIKSSON, CHRISTER ..... N91-32388
ERNSBERGER, U. ..... N91-32373
ESKANDARIAN, AZIM ..... N91-32507
ESTEFAN, J. A. ..... N91-32251
ESTRELLA, R. M. ..... N91-32475
ETIENNE, M. ..... N91-32324
EULER, HANS-JUERGEN ..... N91-32129
EVETTS, J. E. ..... N91-32987
EVTEEV, B. F. ..... N91-32719
EYBERT-BERARD, A. ..... N91-32649

## F

FACHON, JEAN-CHRISTOPHE ..... N91-32382
FADDOUL, JAMES R. ..... N91-32161
FALCO, B. ..... N91-32454
FALCONE, A. ..... N91-32231
FALL, S. MICHAEL ..... N91-33025
FANG, JISHENG ..... N91-32083
FANG, Y. ..... N91-32989
FANTIN, D. M. ..... N91-32749
FARRELL, R. ..... N91-32405
FARREN, J. ..... N91-32362
FAURE, F. ..... N91-32699
FEENSTRA, R. ..... N91-32971
FEIGELMAN, MICHAIL V. ..... N91-32988
FERGUSON, SAMUEL W. ..... N91-32086
FERLAND, GARY J. ..... N91-33025
FERRANDO, WILLIAM A. ..... N91-32224
FERRANTE, JOHN ..... N91-32204
N91-32215
FERRIERES, X. ..... N91-32637
N91-32648
FESQUET, J. ..... N91-32364
FESSENDEN, T. J. ..... N91-32909
FICHTEL, CARL E. ..... N91-33023
FICHTNER, H.-L. ..... N91-33052
FIDLER, R. ..... N91-32376
FIELD, GEORGE ..... N91-33030
FIJANY, AMIR ..... N91-32805
FILUK, A. B. ..... N91-32908
FINK, PAMELA K. ..... N91-32823
N91-32827
N91-32830
FINN, SCOTT R. ..... N91-32183
FISHER, D. L. ..... N91-32945
FISHER, J. R. ..... N91-33018
FISHER, RICHARD J. ..... N91-32636
N91-32640
FISK, Z. ..... N91-32878
N91-32959
FISKUM, R. J. ..... N91-32239
FITZJARRALD, DAN ..... N91-32661
N91-32663
FLAHAUX, M. ..... N91-32496
FLEISCHER, B. ..... N91-32513
FLESHLER, S. ..... N91-32967
N91-32968
N91-32969
FLETCHER, R. S. ..... N91-33041
FLOURENS, F. ..... N91-32701
FLUSS, M. J. ..... N91-32973
FOKEN, THOMAS ..... N91-32596
FORCHIONE, J. ..... N91-32562
FORD, C. E. ..... N91-32842
FOREMAN, J. ..... N91-32150
FOREMAN, R. J. ..... N91-32919
FORGAN, E. M. ..... N91-32418
N91-32419
FORRESTER, B. D. ..... N91-32146
FOSTER, I. ..... N91-32744
FOUKAL, PETER V. ..... N91-33026
FRANCISCO, SHERMAN G. ..... N91-32120
FRANCO, M. M. ..... N91-32269
N91-32270
N91-32271
FRANCY, FAYE I. ..... N91-32097
FRANKEL, DONALD ..... N91-32646
FRANKLIN, S. W. ..... N91-32185
FRASCA, A. J. ..... N91-32410
FREUND, ROLAND W. ..... N91-32814
N91-32818
N91-32820
N91-32821
N91-32848
FRIEDMAN, HERBERT ..... N91-33023
FRIEL, PATRICIA GRIFFITH ..... N91-32803
FRITZ, T. A. ..... N91-33049
FROGEL, JAY ..... N91-33019
FUELBERG, HENRY E. ..... N91-32682
FUJA, R. S. ..... N91-32860
FUJII, KOZO ..... N91-32049
FUJIMOTO, AKIRA ..... N91-32048
FUJITA, JUNJI ..... N91-32913
FUJITA, T. ..... N91-32956
FUKUDA, MASAHIRO ..... N91-32064
FUKUYAMA, ATSUSHI ..... N91-32932
N91-32933
FUNARIU, O. M. ..... N91-32681
FUNK, D. J. ..... N91-32480
FURUKAWA, MASATO ..... N91-32041

## G

GABILLET, Y. ..... N91-32871
GAHN, RANDALL F. ..... N91-32563
GAIER, JAMES R. ..... N91-32177
GAILLARD, M. K. ..... N91-32880
GAINES, D. P. ..... N91-32916
GAISSER, T. K. ..... N91-33041
GALDO, JOSE M. ..... N91-32377
GARBAGNATI, E. ..... N91-32632
GARCIA-MIGUEL, JUAN A. ..... N91-32712
GARG, SANJAY ..... N91-32143
GARNIER, J. ..... N91-32344
GARRETT, D. N. ..... N91-32413
GARRETT, J. D. ..... N91-32899
GARRIDO, F. ..... N91-32379
GARY, S. P. ..... N91-33049
GASIOT, J. ..... N91-32363
N91-32364
GATLEY, IAN ..... N91-33019
GAUL, S. J. ..... N91-32352
GAUTHIER, D. ..... N91-32700
N91-32701
GAUTHIER, PATRICE ..... N91-32102
GAVEL, D. T. ..... N91-32501
GAWRONSKI, W. ..... N91-32268
GEHRZ, ROBERT ..... N91-33019
GEIST, G. A. ..... N91-32834
GERARD, E. ..... N91-32322
GERMANA, GUY T. ..... N91-32094
GERY, M. ..... N91-32583
GIACCONI, RICCARDO ..... N91-33023
GIBAUD, A. ..... N91-32978
GIESY, P. J. ..... N91-32504
GILBERT, JOHN R. ..... N91-32847
GILL, S. P. ..... N91-32560
GILLAND, J. H. ..... N91-32164
GILLETT, FREDERICK ..... N91-33019
GILLILAND, RONALD L. ..... N91-33026
GILMAN, P. S. ..... N91-32200
GILYARD, G. B. ..... N91-32140
GINERIS, DENISE J. ..... N91-32088
GINLEY, D. S. ..... N91-32962
GIORI, K. L. ..... N91-32616
GISLER, G. R. ..... N91-33049

GIUDICI, ROBERT J. ..... N91-32630
GLASSER, A. H. ..... N91-32938
GLEAVE, SUSAN ..... N91-32772
GLYNN, M. S. ..... N91-32715
GOBIN, V. ..... N91-32605
GOCKE, ROBYN ..... N91-32780
GOERTZ, C. K. ..... N91-33043
GOERZ, D. A. ..... N91-32409
GOLD, R. ..... N91-32886
GOLDSACK, STEPHEN J. ..... N91-32825
GOLKA, ROBERT K., JR. ..... N91-32728
GONZALEZDELAMO, JOSE ANTONIO ..... N91-32293
GOODLOE, CAROLYN C. ..... N91-32630
GOODMAN, H. MICHAEL ..... N91-32668
GOODMAN, STEVEN J. ..... N91-32661
N91-32667
GOODRICH, LEWIS R., SR. ..... N91-32511
GORDON, B. M. ..... N91-32893
GORDON, G. H. ..... N91-32185
GORDON, SANFORD ..... N91-32141
GORETTA, K. C. ..... N91-32966
GOSBEE, JOHN ..... N91-32777
N91-32778
N91-32779
N91-32781
N91-32782
N91-32783
N91-32784
N91-32785
N91-32787
N91-32788
N91-32789
GOSS, W. MILLER ..... N91-33018
GOTO, YUKIHIRO ..... N91-32607
GOTT, G. F. ..... N91-32244
GOTTESFELD, S. ..... N91-32573
GOUTELARD, C. ..... N91-32241
GOWER, G. L. ..... N91-32577
GRAMSCH, E. ..... N91-32889
GRANDE, D. H. ..... N91-32180
GRANDO, J. ..... N91-32637
N91-32648
GRANRYD, E. ..... N91-32991
GRANT, N. J. ..... N91-32218
GRASDALEN, GARY ..... N91-33020
GRASZ, E. L. ..... N91-32501
GRAVES, THOMAS JOSEPH ..... N91-32498
GRAY, D. L. ..... N91-32274
GRAY, THOMAS H. ..... N91-32773
GREEN, JOHN A. ..... N91-32071
GREENTHANER, NANCY K. ..... N91-32780
GREENWOLL, D. A. ..... N91-32399
GREGORIS, G. ..... N91-32300
N91-32312
GRIFFIN, K. L. ..... N91-32415
GRIFFIN, MICHAEL J. ..... N91-32762
N91-32766
GRIFFITH, A. ..... N91-32562
GRIGGER, DAVID J. ..... N91-32553
GRIMBERG, ODILE ..... N91-32323
GRINDLAY, JONATHAN E. ..... N91-33023
GROENEWEG, J. F. ..... N91-32075
GROESENEKEN, G. ..... N91-32295
GRONSKY, R. ..... N91-32958
GROPP, W. ..... N91-32744
N91-32854
GRUSH, D. J. ..... N91-32715
GUEDRY, FRED E. ..... N91-32761
N91-32763
GUER, T. M. ..... N91-32958
GUESS, TERRELL M. ..... N91-32776
N91-32779
GUILLORY, ANTHONY R. ..... N91-32664
GUIMARAES, L. ..... N91-32842
GUINAN, M. W. ..... N91-32979
GUPPY, ANDREW ..... N91-32772
GURNETT, D. A. ..... N91-33043
GUSTAFSSON, BERTIL ..... N91-32427
GUTKNECHT, MARTIN H. ..... N91-32820
GUZMAN, F. ..... N91-32590

## H

HAGEDORN, NORMAN H. ..... N91-32551
HAGEN, MARTIN ..... N91-32249
HAGHIGHI, H. ..... N91-32973
HAIGH, S. J. ..... N91-32638
N91-32642
N91-32705
HAINES, J. E. ..... N91-32308
HAINES, R. F. ..... N91-32846
HALAMA, H. ..... N91-32907
HALES, J. E. ..... N91-32738
HALL, KENNETH C. ..... N91-32442
HALL, L. C. ..... N91-32758
HALL, RICHARD BRIAN ..... N91-32173
HALLET, JOHN ..... N91-32533
HALPERT, G. ..... N91-32566
N91-32567
HAMITER, LEON ..... N91-32370
HAMMEL, P. C. ..... N91-32959
HAMMOND, R. H. ..... N91-32971
HAMMOND, STEVEN W. ..... N91-32864
HANCOCK, B. K. ..... N91-32358
HANNON, C. T. ..... N91-32301
HANSEN, C. FREDERICK ..... N91-32187
HANSEN, R. ..... N91-32915
HARBOE-SOERENSEN, R. ..... N91-32357
HARDWICK, C. J. ..... N91-32638
N91-32639
N91-32705
HARLEY, P. ..... N91-32587
HARRIS, A. L. ..... N91-32873
HARRIS, D. W. ..... N91-32560
HARRIS, HUGH ..... N91-33031
HARRIS, JOHN ..... N91-32772
HARRIS, STEPHEN ..... N91-32996
HARRISON, A. K. ..... N91-32457
N91-32467
HART, JOHN E. ..... N91-32675
HART, L. ..... N91-32185
HARWOOD, T. L. ..... N91-32641
HASHIMOTO, KEISUKE ..... N91-32064
HASTINGS, J. B. ..... N91-32920
HATTA, NATSUO ..... N91-32052
HAVLEN, ROBERT ..... N91-33031
HAWRYLUK, A. M. ..... N91-32916
N91-32918
HAYDEN, Y. T. ..... N91-32227
N91-32985
HAYES, J. A. ..... N91-32380
HAYES, T. ..... N91-32328
HAYNES, D. L. ..... N91-32899
HAYTHORNTHWAITE, R. ..... N91-32360
HEESCHEN, DAVID ..... N91-33017
N91-33018
HEESTAND, R. L. ..... N91-32218
HEFFNER, R. H. ..... N91-32959
HEIDRICH, J. ..... N91-32503
HEIKES, B. ..... N91-32739
HEINRICH, RICHARD E. ..... N91-32128
HELFAND, DAVID J. ..... N91-33023
N91-33028
HELLMANN, J. R. ..... N91-32178
HENKNER, JENS ..... N91-32468
HENKUS, J. C. ..... N91-32396
HENRY, ELBERT J. ..... N91-32116
HERGET, C. J. ..... N91-32501
HERMAN, J. W. ..... N91-32207
HERMAN, M. ..... N91-32538
HERMAN, R. G. ..... N91-32193
HERREN, L. TANDY ..... N91-32823
N91-32827
HERRMANN, HEINZ ..... N91-33000
HERRMANNSFELDT, W. B. ..... N91-32906
HESS, JEAN-MARIE ..... N91-32359
HEWETT, M. D. ..... N91-32851
HIBBARD, WILLIAM L. ..... N91-32670
HIDEKUMA, S. ..... N91-32956
HIEBERT, J. C. ..... N91-32887
HILBERT, D. W. ..... N91-32587
HILDEBRAND, ROGER ..... N91-33019
HILL, GARY ..... N91-32071
HILL, J. V. ..... N91-32413
HILL, S. G. ..... N91-32231
HILLYER, CHARLES C. ..... N91-32735
HINEDI, S. ..... N91-32260
N91-32261
HINO, TAKANORI ..... N91-32058
HIRAI, KENICHI ..... N91-32036
HIROMOTO, R. E. ..... N91-32863
HIROSE, HIDEHIRO ..... N91-32047
HIRSCH, C. ..... N91-32428
HISCOX, WILLIAM L. ..... N91-32618
HOCHBRUCK, MARLIS ..... N91-32848
HODGE, A. J. ..... N91-32185
HOEGLUND, INGMAR ..... N91-32299
HOEKSTRA, R. ..... N91-32914
HOJO, HITOSHI ..... N91-32934
HOLLAND, A. ..... N91-32340
HOLLANDERS, H. ..... N91-32435
N91-32436
HOLLE, RONALD L. ..... N91-32703
N91-32712
HOLLOWAY, SIDNEY E., III ..... N91-32511
HOLT, STEPHEN S. ..... N91-33023
HOMA, H. ..... N91-32978
HONG, WAN-SHICK ..... N91-32210
HOOD, ROBBIE ..... N91-32665
HOPF, CH. ..... N91-32615
HOPKINSON, GORDON R. ..... N91-32339
HORII, KENJI ..... N91-32652
N91-32654
HOROWITZ, PAUL ..... N91-33028
HORTON, L. L. ..... N91-32960
HOSHINO, K. ..... N91-32956
HOSKING, F. M. ..... N91-32944
HOSOKAWA, IWAO ..... N91-32062
HOUCK, JAMES ..... N91-33017
N91-33019
HOUSE, F. A. ..... N91-32483
HOVENAC, EDWARD A. ..... N91-32474
HOWELL, R. H. ..... N91-32973
HSIEH, J. H. ..... N91-32505
HSU, LIANG C. ..... N91-32591
HU, HONG-YAO ..... N91-33036
HU, HUANLING ..... N91-32540
HU, Y. F. ..... N91-32807
HUANG, C.-K. ..... N91-32567
HUANG, J. ..... N91-32586
HUANG, T. C. ..... N91-32208
HUBERT, M. ..... N91-32496
HUGGINS, R. A. ..... N91-32958
HUIZING, A. G. ..... N91-32246
HULBERT, S. L. ..... N91-32927
HULL, D. G. ..... N91-32157
HUMMER, J. A. ..... N91-32499
HUNG, R. J. ..... N91-32236
HUNTEN, DONALD ..... N91-33017
N91-33027
HUNTER, MELINDA ..... N91-32692
HUNYADY, S. J. ..... N91-32625
HUTCHINGS, R. B. ..... N91-32202
HUXFORD, T. J. ..... N91-32218
HUYNH, LOC C. ..... N91-32071
HYMERS, R. ..... N91-32387

## I

ICHIMURA, MAKOTO ..... N91-32934
IDA, K. ..... N91-32956
IDE, J. P. ..... N91-32395
IDONE, V. ..... N91-32649
IIYOSHI, A. ..... N91-32957
ILLINGWORTH, A. J. ..... N91-32710
ILLINGWORTH, GARTH ..... N91-33021
IMHOFF, MARC L. ..... N91-32546
INGMANN, PAUL ..... N91-32597
INOUE, MASAHIRO ..... N91-32041
INUTAKE, MASAAKI ..... N91-32934
IREDELL, DAN H. ..... N91-32109
ISHIGAKI, HIROSHI ..... N91-32053
N91-32054
N91-32055
N91-32056
N91-32057
ISHIGURO, TOMIKO ..... N91-32035
ISHII, M. ..... N91-32466
ISHII, RYUJI ..... N91-32052
ISHIZAKA, KOUICHI ..... N91-32063
ISII, KATUYA ..... N91-32051
ISKOVITZ, I. ..... N91-32523
ISLER, JOSEPH R. ..... N91-32593
ISSA, T. N. ..... N91-32278
ISSAC, F. ..... N91-32605
N91-32637
ITOH, KATSUHIRO ..... N91-32061
ITOH, KIMITAKA ..... N91-32931
N91-32932
N91-32933
N91-32954
ITOH, SANAE-I. ..... N91-32930
N91-32931
N91-32932
N91-32933
N91-32954
IZQUIERDO, JOSE A. ..... N91-32377

## J

JACAK, B. V. ..... N91-32912
JACKSON, W. E. ..... N91-32892
JACOBS, PETER A. ..... N91-32463
JAECKEL, LOUIS A. ..... N91-32797
JAEGER, HORST ..... N91-32536
JAENISCH, H. M. ..... N91-32221
JAILLOT, F. ..... N91-32605
JAMES, K. M. ..... N91-32405
JAMESON, R. A. ..... N91-32905
JANKOWSKI, A. F. ..... N91-32919
JANSS, J. ..... N91-32496
JANSSEN, H. G. M. ..... N91-32813
JARZEMBSKI, M. ..... N91-32666
JATEGAONKAR, RAVINDRA ..... N91-32076
JEDLOVEC, GARY J. ..... N91-32664

JEFFRIES, H. N91-32583
JENKINS, J. T. N91-32453
JENNINGS, B. K. N91-32890
JENNINGS, S. N91-32375
JEROME, S. M. N91-32875
JESSUP, E. R. N91-32834
JIA, WEI N91-32040
JIN, IK-MIN N91-32144
JOHLANDER, BENGT N91-32332
JOHNSEN, BJOERN A. N91-32148
N91-32188
JOHNSON, D. D. N91-32220
JOHNSON, E. D. N91-32920
JOHNSON, K. C. N91-32572
JOHNSON, MARJORY J. N91-33005
JOHNSON, N. F. N91-32770
JOHNSON, S. N91-32362
JOHNSON, WAYNE N91-32134
JOHNSTON, KENNETH J. N91-33022
JOHST, D. N91-32366
JONES, C. M. N91-32899
JONES, CHRISTINE N91-33031
JONES, D. A. N91-32452
JONES, IRBY W. N91-32511
JONES, J. A. N91-32378
JONES, J. J. N91-32625
JONES, JAMES J. N91-32609
JONES, K. W. N91-32893
JONES, KENNETH R. N91-32564
JONES, P. D. N91-32742
JONES, WILLIAM D. N91-32677
JONGEJANS, A. N91-32106
JORDAN, D. T. N91-32694
JORGENSEN, CHARLES C. N91-32799
N91-32859
JOSEPH, HASKEL M. N91-32297
JOYCE, J. J. N91-32878
JUDAY, RICHARD D. N91-32922
JURAS, R. C. N91-32899
JUSTUS, C. G. N91-33045


## K


KACKLEY, N. N91-32561
KAGEYAMA, A. N91-32592
KAIDEN, TAKASHI N91-32045
KAISER, D. P. N91-32741
KAISER, J. H. N91-32973
KALDEICH, BRIGITTE N91-32291
KAMATA, M. N91-32936
KANAO, TADASHI N91-32652
KANAZAWA, I. N91-32889
KANDALGAONKAR, S. S. N91-32721
KANEFSKY, BOB N91-32816
KANEMATSU, EMI N91-32039
KANERVA, PENTTI N91-32545
N91-32802
KANG, K. N91-32888
KANG, NAM KOOK N91-32519
KAO, C. C. N91-32920
KAPLAN, P. N91-32522
KARANGELEN, CAROLYN CEDER N91-32461
KARDAUN, O. N91-32931
KARE, J. T. N91-32490
KARL, T. R. N91-32741
KARLSEN, PER J. N91-32148
KASAHARA, AKIRA N91-32671
KAWACHI, KEIJI N91-32066
KAWAHATA, KAZUO N91-32913
KAWASAKI, ZEN-ICHIRO N91-32647
N91-32652
KAYNAK, UNVER N91-32449
KELLEHER, A. N91-32336
KELLER, BIRGIT N91-32748
KELLER, RUDOLF N91-32550
KELLERMANN, KENNETH I. N91-33018
KELLY, P. M. N91-32742
KELLY, W. M. N91-32316
KEMP, P. R. N91-32587
KENGLA, CHARLES A. N91-32120
KENNEDY, J. R. N91-32200
KENNEDY, JOHN M. N91-33013
KENT, S. S. N91-32273
KENWARD, P. D. N91-32809
KERLEY, G. I. N91-32233
N91-32843
KERN, ALEXANDER N91-32644
KERR, J. A. N91-32353
KERR, JAMES N91-32224
KERR, L. J. N91-32140
KEY, J. F. N91-32218
KIBBLEWHITE, EDWARD N91-33022
KIESSLING, FRITZ N91-32142
KIKUCHI, KAZUO N91-32064
N91-32068
N91-32069
KIM, D. N91-32987
KIM, JAE H. N91-32489
KIM, SEONG JOONG N91-32411
KIRKENDALL, T. D. N91-32555
KIRKPATRICK, R. C. N91-32937
KIZZEE, VICTOR D. N91-32786
N91-32787
N91-32790
N91-32791
N91-32792
KLARER, P. R. N91-32858
KLEB, WILLIAM L. N91-32084
KLEIN, A. C. N91-32186
KLEINHEMPEL, WERNER N91-32242
KLEINMANN, SUSAN G. N91-33028
KLEMM, R. A. N91-32967
KLIER, K. N91-32193
KNAPP, G. S. N91-32975
KNAUR, JAMES A. N91-32725
KNEE, H. E. N91-32774
KNIGHT, D. J. E. N91-32872
KOCH, MICHAEL N91-32999
KOIKE, MASATO N91-32835
KOMATSU, MASATOMO N91-32059
KOMURO, HIROSHI N91-32607
KONOPELCHENKO, B. G. N91-32861
KOONTZ, STEVEN N91-32947
KOSEFF, J. R. N91-32465
KOSHIOKA, YASUHIRO N91-32047
N91-32060
KOSITSKY, J. N91-32651
KOSKI, J. A. N91-32944
KOTHE, G. N91-32752
KOURA, KATSUHISA N91-32039
KOZLOWSKI, M. R. N91-32917
KRAMER, G. N91-32369
KREHBIEL, P. R. N91-32695
KREITZBERG, CARL W. N91-32688
KREMER, FRANS G. J. N91-32131
N91-32139
KRETTENAUER, KILIAN N91-32439
KRIDER, E. PHILIP N91-32711
KRIJGSMAN, J. N91-32469
KRISHNAMURTI, T. N. N91-32686
KRULL, W. A. N91-32352
KRUPA, DEBRA T. N91-32781
N91-32782
N91-32784
N91-32786
N91-32787
N91-32788
N91-32789
KUB, FRANCIS J. N91-32471
KUHN, RICHARD E. N91-32070
KUNO, Y. N91-32936
KUNTZ, HJALMAR N91-32995
KUO, C. C. JAY N91-32845
KUO, CHUNG FENG JEFFREY N91-32495
KURKI-SUONIO, H. N91-33051
KURODA, SHINICHI N91-32049
KURTH, W. S. N91-33043
KURTZ, S. R. N91-32976
KUWAHARA, KUNIO N91-32051
KUZAY, T. M. N91-32982
KWAK, J. F. N91-32962
KWAY, W. L. N91-32481
KWOK, W. K. N91-32967
N91-32968
N91-32989


## L


LABAW, CLAYTON C. N91-32926
LACONTI, A. B. N91-32562
LACROIX, D. N91-32367
LAFONTAINE, FRANK N91-32665
N91-32668
LAFONTAINE, VADA N91-32668
LAI, B. N91-32928
LAKE, GRAHAM C. N91-32106
N91-32113
LAM, B. N91-32262
LAMBERT, H. H. N91-32140
LAMBERTY, GREGORY L. N91-32692
LAMBIOTTE, JULES J. N91-32841
LANAGAN, M. N91-32255
LANCE, D. G. N91-32185
LANDER, J. F. N91-32747
LANDIS, GEOFFREY A. N91-33046
LANE, B. N91-32336
LANE, DENNIS D. N91-32532
LANE, S. N. N91-32899
LANGFORD, M. D. N91-32482
LAPENTA, BILL N91-32661
LAPENTA, WILLIAM M. N91-32688
LAPOINTE, MICHAEL R. N91-32162
LARIGALDIE, S. N91-32601
N91-32650
LAROCHE, P. N91-32620
N91-32649
LAUGHLIN, R. B. N91-32970
LAWRENCE, J. N91-32878
LAWRENCE, R. J. N91-32490
LAWRENCE, SCOTT L. N91-32433
LAZARETH, O. N91-32160
LEASURE, C. S. N91-32582
LEBAS, T. P. N91-32745
LEE, ANTHONY C. L. N91-32707
LEE, CHING TSUNG N91-32486
LEE, ELIZABETH M. N91-32084
LEE, I. Y. N91-32899
LEE, M. C. N91-32280
LEE, MARK C. N91-32240
LEE, P. N91-32277
LEE, S. DANIEL N91-32837
N91-32838
N91-32839
LEE, S. L. N91-32418
N91-32419
LEE, V. Y. N91-32958
LEEPER, R. J. N91-32942
LEES, M. I. N91-32708
N91-32710
LEHMANN, B. N91-32337
LEINER, BARRY M. N91-32472
N91-32846
LEMENAGER, J. M. N91-32305
LEMMON, J. J. N91-32281
LENNON, C. N91-32713
LEONE, J. M., JR. N91-32743
LEPPARD, W. R. N91-32197
LEPPIN, HANS-PETER N91-32997
LERAY, J. L. N91-32346
LESLIE, FRED W. N91-32660
N91-32662
LESUER, D. R. N91-32980
LEVEY, BRIAN S. N91-32085
LEVITT, K. N91-32853
LEVY, R. N91-32252
LEYNAERT, J. N91-32082
LI, QIANG N91-32963
LI, T. K. N91-32936
LI, Z. P. N91-32877
LIBBY, S. B. N91-32970
LIBKIND, M. A. N91-32483
LIDHOLM, S. U. N91-32301
LIDINSKY, W. N91-32849
LIENEWEG, U. N91-32327
LIFF, DALE R. N91-32237
LILLEY, G. M. N91-32450
LIM, E. C. N91-32578
LIN, CHIN S. N91-32579
LIN, SHU N91-32288
LIN, Y.-S. N91-32327
LINCOLN, CRAIG WALTER N91-33037
LINCOLN, DAVID T. N91-32823
LINDEMUTH, I. R. N91-32937
LINDER, F. N91-32367
LINDSAY, C. E. N91-32303
N91-32318
LINSKY, JEFFREY L. N91-33028
LIPKE, DAVID W. N91-32111
LIU, J. Z N91-32973
LIU, J. Z. N91-32989
LIU, K. C. N91-32179
LJOENES, MARITA N91-32148
LLOYD, A. R. J. M. N91-32424
LLOYD, CHARLES W. N91-32776
N91-32780
N91-32783
N91-32785
N91-32793
LLOYD, S. N91-32633
LO, K. K. N91-32207
LOCK, JAMES A. N91-32474
LOEFFLER, ROLAND N91-32306
LONG, CORMAC S. N91-32316
LONGONI, F. N91-32329
LOONEY, L. D. N91-32921
LOPEZ, G. N91-32868
LOPEZ, RAUL E. N91-32703
N91-32712
LOPEZCOTARELO, M. N91-32358
LORGE, FRANK L. N91-32099
LOUP, F. N91-32364
LOYSELLE, PATRICIA L. N91-32556
N91-32557
LU, H.-I. N91-32662
N91-32663
LUDEWIG, H. N91-32160
LUMB, D. N91-32340

LUMPKIN, A. H. ..... N91-32479
LUNDQUIST, STIG ..... N91-32614
LUNSFORD, J. H. ..... N91-32191
LUPEIKO, A. V. ..... N91-32729
LUPO, ANTHONY R. ..... N91-32692
LUTERAN, FRANK ..... N91-32714
LYNCH, J. T. ..... N91-32311
LYNCH, PRISCA L. ..... N91-32072
LYNN, K. G. ..... N91-32889
LYONS, P. B. ..... N91-32921
LYSEJKO, M. ..... N91-32302

## M

MAASCH, KIRK A. ..... N91-32687
MACAL, C. M. ..... N91-32860
MACCRACKEN, MICHAEL C. ..... N91-32589
MACKAY, G. ..... N91-32360
MACKIN, CLIFFORD W. ..... N91-32092
MACLEAN, DONALD F. ..... N91-32104
MACRANDER, A. T. ..... N91-32975
MADORE, BARRY F. ..... N91-33028
MADURA, J. ..... N91-32704
MADZSAR, GEORGE C. ..... N91-32167
MAEDA, H. ..... N91-32931
MAES, H. E. ..... N91-32295
MAESTRE, M. F. ..... N91-32915
MAHAN, G. D. ..... N91-32214
MAIDLOW, KRISTIN ..... N91-32793
MAIER, L. ..... N91-32713
MAIER, MICHAEL W. ..... N91-32712
MAILLE, HENRI ..... N91-32871
MAJKRZAK, C. F. ..... N91-32978
MAJUMDAR, S. ..... N91-32232
MAKOWIECKI, D. M. ..... N91-32919
MALHERBE, C. ..... N91-32620
MALIK, S. K. ..... N91-32969
MALLINSON, N. M. ..... N91-32302
MANCE, S. C. ..... N91-32980
MANDELL, J. F. ..... N91-32180
MANHART, PAUL K. ..... N91-32923
MANKBADI, REDA R. ..... N91-32458
N91-32459
MANKO, DAVID J. ..... N91-32558
MANOHAR, G. K. ..... N91-32721
MANSKI, DETLEF ..... N91-32159
MANTENIEKS, MARIS A. ..... N91-32162
MARCH-LEUBA, C. ..... N91-32842
MARCINIAK, T. J. ..... N91-32506
MARGON, BRUCE ..... N91-33023
MARICLE, D. L. ..... N91-32570
MARKHAM, SANFORD M. ..... N91-32794
MARKS, T. S. ..... N91-32186
MARMIGNON, C. ..... N91-32436
MARON, Y. ..... N91-32908
MARR, W. W. ..... N91-32506
MARSDEN, S. ..... N91-32314
MARSHALL, A. F. ..... N91-32971
MARTIN, ANTHONY J. ..... N91-32125
MARTIN, JORGE M. ..... N91-32857
MARTIN, WILLIAM J. ..... N91-32783
MASCHKE, PETER ..... N91-32090
MASSENAT, MICHEL ..... N91-32309
MASSOGLIA, PETER L. ..... N91-32094
N91-32098
MASTERSON, M. J. ..... N91-32405
MATHEWS, G. J. ..... N91-33038
MATIJASEVIC, V. C. ..... N91-32971
MATSUDA, T. ..... N91-32931
MATSUNAGA, KOJI ..... N91-32069
MATSUO, HIROSHI ..... N91-32913
MATSUO, YUICHI ..... N91-32067
MATSUOKA, AKINORI ..... N91-32064
MATSUURA, KENJI ..... N91-32652
MATTERN, DUANE L. ..... N91-32143
MATTSSON, S. ..... N91-32342
MAXSON, J. A. ..... N91-32992
MAXWELL, E. ..... N91-32575
MAYA, TAKASI ..... N91-32069
MAYBEE, J. C. ..... N91-32504
MAYERCHECK, W. D. ..... N91-32499
MAYHALL, D. J. ..... N91-32286
MAZUR, VLADISLAV ..... N91-32600
N91-32602
MCCALLUM, J. C. ..... N91-32960
MCCARTHY, K. ..... N91-32340
MCCATTY, S. A. ..... N91-32561
MCCAUL, E. W., JR. ..... N91-32666
MCCLARNON-MINNIX, MARY A. ..... N91-32116
MCCORMICK, M. P. ..... N91-32535
MCCRAY, RICHARD ..... N91-33029
MCDOWALL, R. L. ..... N91-32715
MCEACHEN, ANGUS D., III ..... N91-32112
MCELROY, J. F. ..... N91-32552
MCGUIRK, JAMES P. ..... N91-32685
N91-32690
MCINTYRE, STANLEY D. ..... N91-32161
MCKAY, G. A. ..... N91-32659
MCKEE, CHRISTOPHER F. ..... N91-33017
N91-33025
MCKENNA, PAUL M. ..... N91-32733
MCKINLEY, B. A. ..... N91-32792
MCKUNE, JOHN ..... N91-32720
MCLEES, ROBERT E. ..... N91-32132
MCMANUS, HUGH LESLIE NICHOLAS ..... N91-32171
MCMILLAN, V. C. ..... N91-32217
MCTIGUE, D. F. ..... N91-32453
MCVEY, B. D. ..... N91-32493
MEDELIUS, PEDRO J. ..... N91-32610
N91-32629
N91-32697
N91-32734
MELIN, STEFAN A. ..... N91-32617
MELLSTROM, J. A. ..... N91-32253
N91-32268
MENKE, BODO ..... N91-32306
MERRILL, R. D. ..... N91-32501
MERRITT, B. T. ..... N91-32401
MERTEN, K. ..... N91-32394
METT, R. R. ..... N91-32946
METZIG, GUNTHARD ..... N91-32541
MEYER, A. ..... N91-32330
MIJUIN, D. ..... N91-32356
MILLER, CLYDE A. ..... N91-32122
MILLER, E. L. ..... N91-32484
MILLER, G. A. ..... N91-32890
MILLER, JAMES B. ..... N91-32511
MILLER, R. A. ..... N91-32229
MILLER, TIM L. ..... N91-32661
N91-32662
MILLERET, G. ..... N91-32356
MILLIS, MARC G. ..... N91-32163
MILLS, D. M. ..... N91-32975
MILLS, K. C. ..... N91-32201
MILNER, B. ..... N91-32328
MINNETYAN, LEVON ..... N91-32182
MIRFAKHRAIE, KOOROSH ..... N91-32153
MISSOUS, O. ..... N91-32364
MITCHELL, SCOTT JAMES ..... N91-32154
MIURA, Y. ..... N91-32931
N91-32956
MIYAKAWA, JUNICHI ..... N91-32050
MIYAKE, YOSHIAKI ..... N91-32068
MIYOSHI, SYOICHI ..... N91-32934
MIZOBUCHI, YASUHIRO ..... N91-32065
MLADENOVIC, I. ..... N91-32634
N91-32698
MOCHIZUKI, MUNEKAZU ..... N91-32053
N91-32055
N91-32057
MOLLOY, N. D. ..... N91-32125
MONEY, K. E. ..... N91-32760
N91-32764
N91-32765
MONK, A. M. ..... N91-32275
MONROE, D. K. ..... N91-32490
MONTGOMERY, L. K. ..... N91-32969
MOOK, H. A. ..... N91-32418
N91-32419
N91-32902
MOORE, C. B. ..... N91-32625
MOORE, C. F. ..... N91-32900
MOORE, TRUMAN W., JR. ..... N91-32725
MORAN, J. P. ..... N91-32219
MORAN, M. J. ..... N91-32898
MORDECHAI, S. ..... N91-32900
MOREAU, J. P. ..... N91-32601
MOREL, T. ..... N91-32701
MORGAN, J. F. ..... N91-32886
MORGAN, S. H. ..... N91-32983
MORI, M. ..... N91-32931
N91-32956
MORIOKA, SHIGEKI ..... N91-32052
MORRIS, A. L. ..... N91-32752
MORRISON, DAVID ..... N91-33027
MORRISON, P. J. ..... N91-32464
MOSS, C. E. ..... N91-32882
MOSS, DON ..... N91-32668
MOXNES, JOHN ..... N91-32203
MUELLER, F. M. ..... N91-32397
MUELLER, R. ..... N91-32357
MUELLER, TILMAN ..... N91-32547
MUGHABGHAB, S. ..... N91-32160
MULLER, J. D. ..... N91-32648
MUNSON, D. E. ..... N91-32199
MURAKAMI, S. ..... N91-32929
MURAT, J. ..... N91-32356
MURPHY, LINDA ..... N91-32787
N91-32791
MURTHY, PAPPU L. N. ..... N91-32182
N91-32520
MURTY, ROM ..... N91-32680
MUSSEAU, O. ..... N91-32346
MUSTREDELEON, J. ..... N91-32892
MUURMAN, T. ..... N91-32488
MYERS, ROGER M. ..... N91-32162
N91-32164
MYHRENGEN, HANS ..... N91-33015

## N

NACHTIGAL, NOEL M. ..... N91-32818
N91-32820
NAGASAKI, K. ..... N91-32954
NAGAYAMA, TAKEHIKO ..... N91-32068
NAIK, R. A. ..... N91-32527
NAKAJIMA, NORIYOSHI ..... N91-32955
NAKAMURA, KOICHI ..... N91-32652
N91-32654
NAKAMURA, YOSHIAKI ..... N91-32040
NAKANO, MINORU ..... N91-32647
N91-32652
NAKANO, TAKASHI ..... N91-32041
NALECZ, ANDRZEJ G. ..... N91-32832
NALLASAMY, M. ..... N91-32075
NAMASIVAYAM, S. ..... N91-32614
NAMIOKA, TAKESHI ..... N91-32835
NANEVICZ, J. E. ..... N91-32616
N91-32651
NARITA, KENICHI ..... N91-32607
NASH, T. J. ..... N91-32908
NASON, D. ..... N91-32983
NATESAN, K. ..... N91-32213
NATHAN, TERRENCE ..... N91-32673
NEMES, JOHNNY ..... N91-32110
NESTLERODE, S. R. ..... N91-32178
NETTLES, A. T. ..... N91-32185
NEUMANN, WILLIAM T. ..... N91-32618
NEVINS, M. R. ..... N91-32860
NEWMAN, HARVEY S. ..... N91-32398
NEWMAN, L. ..... N91-32585
NGUYEN, P. ..... N91-32106
NGUYEN, T. M. ..... N91-32560
NIAN, H. L. ..... N91-32975
NICHOLLS, J. P. ..... N91-32358
NICHOLOSON, D. M. ..... N91-32220
NICHOLS, D. ..... N91-32331
NICHOLS, F. A. ..... N91-32505
NICHOLSON, JAMES R. ..... N91-32703
NICINSKI, T. ..... N91-33032
NIEDRA, J. M. ..... N91-32412
NIKOLAIDIS, E. ..... N91-32522
NITTA, KYOKO ..... N91-32043
NIWA, NOBUO ..... N91-32048
NORCROSS, D. W. ..... N91-32897
NORFLEET, WILLIAM T. ..... N91-32792
NORTHCLIFFE, L. C. ..... N91-32887
NORTON, WILLIAM E. ..... N91-32795
NOYES, ROBERT ..... N91-33017
N91-33026
NOZAKI, OSAMU ..... N91-32068
N91-32069

## O

OBANNON, B. J. J. ..... N91-32415
OBERS, N. A. J. ..... N91-32866
OEVEL, W. ..... N91-32861
OGAWA, SATORU ..... N91-32035
OGINO, JUN ..... N91-32045
OGLESBY, ROBERT ..... N91-32687
OHOTNICKY, MICHELE M. ..... N91-33004
OHSUGA, SETSUO ..... N91-32033
OKAMOTO, MASAO ..... N91-32955
OKEEFFE, H. BRIAN ..... N91-32101
OLDFIELD, S. ..... N91-32248
OLEYNIK, G. ..... N91-33032
OLIVER, F. ..... N91-32974
OLSEN, D. K. ..... N91-32899
OLSHAUSEN, BRUNO ..... N91-32798
OMALLEY, G. ..... N91-32328
OMATHUNA, C. ..... N91-32328
ONEILL, B. ..... N91-32336
ONSTOTT, ROBERT G. ..... N91-32088
ONYSZCHUK, I. M. ..... N91-32264
N91-32265
OOSTERVELD, W. J. ..... N91-32768
OPPENHEIM, A. K. ..... N91-32992
OPSTAD, AASE M. ..... N91-32148
ORAM, TIMOTHY D. ..... N91-32711
ORSAK, DEBRA ..... N91-32782
N91-32785
ORTIZ, GERARDO G. ..... N91-32254
N91-32255
OSGOOD, R. M., JR. ..... N91-32416
OSHEA, P. G. ..... N91-32492

OSTRIKER, JEREMIAH P. N91-33017
N91-33029
OSULLIVAN, M. N91-32336
OTA, MASAHIRO N91-32037
OTOSHI, T. Y. N91-32269
N91-32270
N91-32271
OVERMAN, ANDREA L. N91-32841

## P

PADIN, STEVEN N91-32254
PAGE, J. F. N91-32301
PALMER, HARVEY J. N91-32792
PANDOLFO, LIONEL N91-32687
PAPAGEORGIU, E. N91-32876
PAPAILIOU, D. D. N91-32447
PAQUETTE, STEVEN P. N91-32775
PARK, J. H. N91-32213
PARKER, D. R. N91-32333
PARKER, DAVID B. N91-32840
PARKER, J. L. N91-32936
PARMANTIER, J. P. N91-32699
PARNAS, KEMAL LEVEND N91-32184
PARTHASATHY, ARVIND N91-32558
PASTERNAK, M. P. N91-32961
PATIN, Y. N91-32346
PATTERSON, MICHAEL J. N91-32158
N91-32164
PATTERSON, RICHARD L. N91-33014
PATTERSON, W. J. N91-32185
PAUL, D. M. N91-32418
N91-32902
PAUL, D. MCK. N91-32419
PAULSSON, MAGNUS N91-32350
PAYNE, R. C. N91-32873
PAYNE, S. A. N91-32227
N91-32481
N91-32985
PEARSON, D. W. N91-32894
PECKHAM, D. H. N91-32082
PEDERSEN, OLE N91-32313
N91-32362
PEDROTTI, L. R. N91-32502
PEERENBOOM, J. P. N91-32860
PEGELS, HANS N91-32998
PELTIER, J. M. N91-32200
PELUSO, S. E. N91-32482
PENG, T. K. N91-32273
PENNER, J. E. N91-32588
PENNLINE, JAMES A. N91-32806
PENOU, X. N91-32367
PEPPER, L. N91-32782
PERALA, RODNEY A. N91-32656
N91-32733
PERKEY, DONALD J. N91-32688
PERKINS, K. N91-32160
PERRING, T. G. N91-32902
PETERSON, RANDALL L. N91-32134
PETERSON, S. J. N91-33053
PETRAVICK, D. N91-33032
PETROV, N. I. N91-32723
N91-32729
PETROVA, G. N. N91-32723
PETTIBONE, J. N91-32503
PFEFFERLE, L. D. N91-32190
PHAM, T. T. N91-32273
PHARAOH, K. I. N91-32872
PHILLION, D. W. N91-32916
PIERCE, J. N91-32317
PIERCE, J. S. N91-32610
PIFER, ALBURT E. N91-32618
PIGINI, A. N91-32632
PINDER, C. N91-32704
PINELLI, THOMAS E. N91-33013
PINSKI, F. J. N91-32220
PITKAENEN, M. N91-32488
PITZ, W. J. N91-32197
PITZER, K. S. N91-32195
POCHA, M. D. N91-32415
PODGORSKI, ANDREW S. N91-32702
PODNIEKS, E. R. N91-33044
POEPPEL, R. B. N91-32232
POIRIER, MICHEL A. N91-32294
POLLINA, R. J. N91-32939
PONCHAK, DENISE S. N91-32287
PONOMARENKO, S. N91-32367
PORDES, R. N91-33032
PORTER, BRUCE W. N91-32826
POSNER, EDWARD C. N91-32250
POST, MADISON J. N91-32679
POWELL, J. R. N91-32160
PRESS, WILLIAM N91-33028
PRESSECQ, F. N91-32298
PRESTON, C. C. N91-32886
PREVOST, H. N91-32364
PRICE, M. E. N91-33053
PRICE, W. FRANK N91-32097
PUESCHEL, RUDOLF F. N91-32528
PUNJABI, A. N91-32940
PURR, E. N91-32368

## Q

QIMING, MA N91-32709

## R

RADKE, R. N91-32338
RAISTRICK, I. N91-32892
RAMAN, GANESH N91-32074
RAMANATHAN, M. N91-32974
N91-32975
RANDTKE, STEPHEN J. N91-32532
RANFONE, S. N91-32876
RATNAKUMAR, B. V. N91-32566
RAUSCH, RUSS D. N91-32084
RAY, INGEBORG L. N91-32114
RAYHRER, B. N91-32262
RAYNER, S. L. N91-32973
RECHENMACHER, R. N91-33032
REDDING, DAVID C. N91-32924
REEDY, R. C. N91-32882
N91-33049
REEVES, G. D. N91-33049
REGIAN, J. WESLEY N91-32827
REGULA, MICHAEL N91-32313
N91-32362
REHMANN, ALBERT N91-32126
REHN, L. E. N91-32965
REID, G. W. N91-32606
REID, MARGARET A. N91-32556
N91-32557
REMER, D. S. N91-32279
REPTON, A. S. N91-32302
RESHOTKO, ELI N91-32074
REUTER, R. C., JR. N91-32400
REVANKAR, S. T. N91-32466
REYES, A. P. N91-32959
REYMANN, WOLFGANG N91-32999
REYNOLDS, J. F. N91-32587
RHODES, C. T. N91-32695
RICE, EDWARD J. N91-32074
RICHARD, PHILIPPE N91-32619
RICHARDSON, R. A. N91-32409
RICHEY, G. K. N91-32082
RICHMOND, G. N91-32485
RIDGWAY, STEPHEN N91-33022
RIEGER, ROLF N91-32313
N91-32362
RIORDAN, C. N91-32575
RIVERS, M. L. N91-32893
RIVIERE, D. N91-32307
RIZK, MAGDI H. N91-32072
ROBERTS, EDWARD F., JR. N91-32635
ROBERTS, J. H. N91-32886
ROBERTS, J. M. N91-32585
ROBERTSON, FRANKLIN R. N91-32661
N91-32663
N91-32688
N91-32691
ROBINET, M. N91-32307
ROBINSON, M. T. N91-32903
ROBINSON, P. J. N91-32740
ROCK, JOHN A. N91-32794
RODDE, K. N91-32335
RODI, W. N91-32446
ROE, P. L. N91-32430
ROENQUIST, EINAR MALVIN N91-32432
ROGERS, DAVID N91-32836
ROGGEN, J. N91-32310
ROHALY, GREGG N91-32686
ROLFE, ERICA N91-32152
ROLLIN, G. N91-32435
ROMANA, L. J. N91-32960
ROSA, R. J. N91-32939
ROSEN, M. D. N91-32487
ROSEN, MICHEL N91-32871
ROSENTHAL, P. N91-32971
ROSENZWEIG, C. N91-32895
ROSIER, L. H. N91-32345
ROSKE-HOFSTRAND, RENATE N91-32126
ROSNER, ROBERT N91-33026
ROSSER, K. E. N91-32147
ROTHERMEL, JEFF N91-32666
ROUGE, C. J. N91-32229
ROUX, A. N91-32330
ROWE, E. N91-32915
RUBINSTEIN, MARCOS N91-32629
N91-32734
RUDOLPH, TERENCE H. N91-32656
N91-32726
RUITER, A. J. M. N91-32612
RUIZENDAAL, P. F. N91-32813
RUNNELS, MARK H. N91-32117
RUPKE, E. N91-32717
N91-32718
RUSHING, DOUG N91-32790
RUSJAN, E. N91-33041
RUSSEL, S. S. N91-32185
RUSSELL, G. J. N91-32891
RUSTANDI, R. R. N91-32752
RYAN, J. N91-32336
RYAN, PAUL R. N91-32124
RYMES, M. N91-32575

## S

SAAD, YOUCEF N91-32865
SADOULET, BERNARD N91-33024
SADR, R. N91-32260
SAITO, SADAMU N91-32038
SAITO, SHIGERU N91-32065
N91-32066
SAKAI, KIYOMI N91-32913
SAKAMOTO, MIZUKI N91-32913
SAKURAGI, TAKUYA N91-32051
SALE, K. N91-32886
SALEEB, A. F. N91-32523
SALEM-SUGUI, S., JR. N91-32966
N91-32974
N91-32986
SALISBURY, K. N91-32633
SALMON, J. T. N91-32483
SALTZMAN, BARRY N91-32687
SAMMONS, T. J. N91-32475
SAMPSON, MICHAEL JOHN N91-32391
SAND, J. R. N91-32991
SANTELLA, M. N91-32209
SANTER, R. N91-32538
SANUKI, H. N91-32933
SANYA, M. K. N91-32978
SAPPEY, A. D. N91-32480
SARANGAPANI, S. N91-32562
SARAVANOS, D. A. N91-32181
SARGEANT, D. N91-32739
SARGENT, WALLACE L. W. N91-33020
SATIJA, S. K. N91-32978
SATO, S. N91-32936
SATO, T. N91-32592
N91-32929
SAUERNHEIMER, KARLHANS N91-32995
SAUERS, I. N91-32285
SAUNDERS-HODGE, SABRINA F. N91-32117
SAVAGE, BLAIR N91-33021
SAWADA, KEISUKE N91-32046
N91-32048
SAYOOD, KHALID N91-32247
SCHALK, R. M. N91-32987
SCHARFEN, GREG N91-32667
SCHAUS, J. E. N91-32506
SCHECHTER, J. N91-32895
SCHIEFEN, JOHN T. N91-32137
SCHILLING, CHRISTOPHER H. N91-32240
SCHIMMEL, MORRY L. N91-32196
SCHIRBER, J. E. N91-32959
SCHMIDT, E. N91-32160
SCHMITT, M. J. N91-32491
SCHNETZER, GEORGE H. N91-32636
N91-32640
SCHOENWALD, BERND N91-32996
SCHOTLAND, R. M. N91-32681
SCHRAMM, DAVID N. N91-33025
N91-33040
SCHRANK, M. N91-32500
SCHREIBER, ROBERT N91-32801
N91-32844
N91-32847
N91-32864
SCHROEDER, HARTMUT N91-32871
SCHRYVER, J. C. N91-32774
SCHUBERT, FRANZ H. N91-32553
SCHULTZ, K. R. N91-32952
SCHULZ, JOHN M. N91-32793
SCHUMACHER, PETRA K. N91-32393
SCHWARTZ, J. A. N91-32258
SCHWARZ, GOTTFRIED N91-32468
SCHWARZE, G. E. N91-32410
N91-32412
SCOTT, B. R. N91-32750
SCOTT, G. L. N91-32403
SCOTT, M. N91-32375
SCOTT, THOMAS MARK N91-32343
SCOTT, W. RICHARD N91-32390
SCUKA, VIKTOR N91-32655

SEARFUS, R. M. ..... N91-32544
SECKEL, D. ..... N91-33041
SECORD, BERTHA B. ..... N91-32754
SECRIST, M. ..... N91-32704
SEELY, G. R. ..... N91-32751
SEKAR, R. R. ..... N91-32506
SELCOW, E. C. ..... N91-32160
SENARD, PASCAL ..... N91-32102
SERAFIN, D. ..... N91-32700
N91-32701
SERAFIN, R. ..... N91-32739
SETTLES, GARY S. ..... N91-32079
N91-32080
SEVE, ALAIN ..... N91-33034
SEYWALD, HANS ..... N91-32155
SHAFI, Q. ..... N91-33041
SHAH, B. ..... N91-32261
SHAIK, K. ..... N91-32257
SHAN, X. ..... N91-32556
SHAO, X. M. ..... N91-32695
SHARPE, P. H. G. ..... N91-32874
SHAW, C. M. ..... N91-32353
SHAW, D. ..... N91-32331
SHEARMAN, E. D. R. ..... N91-32244
SHELL, J. ..... N91-32256
SHELTON, R. ..... N91-32973
SHELTON, W. A. ..... N91-32220
SHEN, D. H. ..... N91-32567
SHERIF, J. S. ..... N91-32279
SHI, DONGLU ..... N91-32966
N91-32986
SHIH, T. H. ..... N91-32460
SHIHABI, M. ..... N91-32261
SHIMIZU, MIHO ..... N91-32050
SHINOHARA, K. ..... N91-32971
SHINOKAZI, KOICHI ..... N91-32381
SHIO, HISASHI ..... N91-32724
SHIRAYAMA, SUSUMU ..... N91-32044
SHIRER, HAMPTON N. ..... N91-32674
SHOLAPURKAR, S. M. ..... N91-32721
SHUMPERT, THOMAS H. ..... N91-32725
SIDDONS, D. P. ..... N91-32920
N91-32974
SIEKHAUS, W. ..... N91-32917
SIEKMEIER, J. A. ..... N91-33044
SIEMON, R. E. ..... N91-32953
SIEVERS, R. H., SR. ..... N91-32502
SIKKA, V. K. ..... N91-32218
SILBERMAN, E. ..... N91-32983
SIMOEN, E. ..... N91-32296
SIMON, M. K. ..... N91-32273
SIMONEN, E. P. ..... N91-32212
SIMONETTI, G. ..... N91-32329
SIMS, GRAHAM D. ..... N91-32174
SINGH, J. P. ..... N91-32232
SINHA, S. K. ..... N91-32978
SIVASHINSKY, G. I. ..... N91-32198
SKINNER, D. J. ..... N91-32200
SKLAD, P. S. ..... N91-32960
SLABE, MELISSA E. ..... N91-32177
SLACK, DAVID CHRISTOPHER ..... N91-32423
SLADE, R. ..... N91-32170
SLOBIN, S. D. ..... N91-32271
SMARR, LARRY ..... N91-33028
SMITH, CHRISTOPHER DUNN ..... N91-32525
SMITH, F. G. ..... N91-32943
SMITH, J. L. ..... N91-32878
SMITH, L. K. ..... N91-32481
SMITH, M. D. ..... N91-32226
SMITH, MATT ..... N91-32668
SMITH, MAUREEN ..... N91-32791
SMITH, PHILLIP J. ..... N91-32692
SMITH, RON ..... N91-32565
SMITH, W. ..... N91-32739
SMITHERS, MARTIN E. ..... N91-32680
SMOOKE, M. D. ..... N91-32190
SMYTH, P. ..... N91-32253
SMYTHE-WRIGHT, D. ..... N91-32580
SNOWDON, M. ..... N91-32372
SNYDER, P. ..... N91-32915
SNYDER, S. S. ..... N91-32752
SOHN, B. ..... N91-32663
SOLAL, F. ..... N91-32973
SOMEKH, R. E. ..... N91-32987
SONG, JOON ..... N91-32245
SOULA, SERGE ..... N91-32653
SOUTHER, ARTHUR ..... N91-32826
SOUYRI, M. ..... N91-32334
SOVERS, O. J. ..... N91-32276
SOVEY, JAMES S. ..... N91-32158
SOVIE, AMY L. ..... N91-32163
SPALVINS, T. ..... N91-32216
SPANNE, P. ..... N91-32893
SPATZ, DAVID M. ..... N91-32591
SPEER, R. D. ..... N91-32482
SPENCE, RODNEY L. ..... N91-32287
SPENCER, ROY W. ..... N91-32665
N91-32683
SPIERS, GARY D. ..... N91-32680
SPILLER, OLAF ..... N91-32613
SPRINGER, T. E. ..... N91-32573
SPRUIJT, C. P. ..... N91-32477
SPRUIJT, H. ..... N91-32314
SRIDHAR, S. ..... N91-32255
SRIKISHEN, J. ..... N91-32663
SRINIVASAN, J. M. ..... N91-32262
SRINIVASAN, SUPRAMANIAM ..... N91-32558
SRIRANGARAJAN, RAJAN ..... N91-32109
SRIVASTAVA, V. ..... N91-32666
STACHETTI, V. ..... N91-32334
STAHMANN, JAMES R. ..... N91-32627
STALS, L. M. ..... N91-32310
STAMERJOHANNS, G. ..... N91-32371
STANTON, P. ..... N91-32277
STEFANUTTI, L. ..... N91-32537
STEGMANN, BARBARA ..... N91-32779
STEIN, J. M. ..... N91-32415
STENDER, WALTER ..... N91-32142
STERNE, P. A. ..... N91-32220
N91-32958
N91-32973
STERNER, S. M. ..... N91-32195
STEURER, P. M. ..... N91-32741
STEVENS, C. O. ..... N91-32179
STEVENS, E. G. ..... N91-32694
STEVENS, R. ..... N91-32744
STEVENS, ROBERT K. ..... N91-32531
STEWART, S. R. ..... N91-32269
N91-32270
N91-32271
STOCKINGER, SABINE ..... N91-32249
STOCKS, G. M. ..... N91-32220
STOFFEL, T. ..... N91-32575
STOJANOFF, V. ..... N91-32974
STONER, G. E. ..... N91-32219
STONESTREET, ROBERT ..... N91-32786
STOREBO, PER B. ..... N91-32696
STOREY, C. ..... N91-32807
STOTT, J. R. R. ..... N91-32767
N91-32769
STOUGHTON, C. ..... N91-33032
STRAUSS, ROBERT ..... N91-32548
STRAYER, M. R. ..... N91-32867
N91-32884
STREETT, CRAIG L. ..... N91-32841
STREIT, G. E. ..... N91-32590
STREIT, R. ..... N91-32503
STROM, STEPHEN ..... N91-33020
STRUIJS, R. ..... N91-32430
STUYVESANT, R. ..... N91-32831
STYGAR, W. A. ..... N91-32942
SU, WEIHAN ..... N91-32539
SUENAGA, M. ..... N91-32972
SUGGS, RON ..... N91-32664
SUICH, RONALD C. ..... N91-33014
SUITS, A. G. ..... N91-32879
SULLIVAN, J. R. ..... N91-32482
SURAMPUDI, S. ..... N91-32567
SUTTON, S. R. ..... N91-32893
SUZUKI, MASAHIRO ..... N91-32042
SUZUKI, N. ..... N91-32931
N91-32956
SUZUKI, NAOYUKI ..... N91-32034
SWAIN, D. W. ..... N91-32950
SWAN, SCOTT A. ..... N91-32514
SWANSON, L. ..... N91-32266
SWETTE, L. ..... N91-32561
SWIFT, C. D. ..... N91-32483
SYLER, R. P. ..... N91-32089
SYN, C. K. ..... N91-32980
SZOEKE, A. ..... N91-32885

## T

TAJIMA, T. ..... N91-32945
TAKAGI, NOBUYUKI ..... N91-32647
TAKAHIRA, MIKINARI ..... N91-32039
TAKAMARU, H. ..... N91-32929
TAKANASHI, SUSUMU ..... N91-32045
N91-32046
N91-32050
TAKAYAMA, KAZUYOSHI ..... N91-32061
TAKEDA, HARUNORI ..... N91-32493
TAKEDA, HIROKI ..... N91-32100
N91-32108
TAKEUCHI, HISAO ..... N91-32069
TAKEUTI, TOSIO ..... N91-32647
TAKIZUKA, T. ..... N91-32931
TAKLE, E. ..... N91-32739
TAKLE, E. S. ..... N91-32743
TAMAI, H. ..... N91-32931
TAMURA, ATSUHIRO ..... N91-32064
N91-32068
N91-32069
TAMURA, HIROSHI ..... N91-32054
TANAKA, G. ..... N91-32476
TANAKA, M. ..... N91-32929
TANAKA, TETSUYA ..... N91-32037
TANAKA, YOSHINORI ..... N91-32062
TANG, JAU ..... N91-32752
TANI, TAKASHI ..... N91-32059
TANI, YOSUHIRO ..... N91-32047
TARANIK, JAMES V. ..... N91-32591
TARTT, D. M. ..... N91-32851
TASTET, P. ..... N91-32344
TAU, ERIC YU ..... N91-32455
TAYLOR, A. D. ..... N91-32902
TAYLOR, P. L. ..... N91-32949
TAYLOR, R. D. ..... N91-32961
TELLER, E. ..... N91-32417
TENCH, R. ..... N91-32917
TENFORDE, T. S. ..... N91-32756
TENNILLE, GEOFFREY M. ..... N91-32841
TERRY, P. ..... N91-32399
TESSEIDRE, C. ..... N91-32438
TEZDUYAR, TAYFAN E. ..... N91-32431
THEIL, A. ..... N91-32246
THEIS, R. ..... N91-32392
THOMAS, A. M. ..... N91-32078
THOMAS, J. B. ..... N91-32262
THOMAS, M. C. ..... N91-32407
THOMAS, R. ..... N91-32695
THOMAS, S. W. ..... N91-32475
THOMPSON, J. A. ..... N91-32358
THOMPSON, J. D. ..... N91-32878
THOMSON, EWEN M. ..... N91-32610
N91-32629
N91-32697
N91-32734
THOMSON, I. ..... N91-32360
THORLEY, G. ..... N91-33033
THOTTAPPILLIL, RAJEEV ..... N91-32736
THROWE, J. ..... N91-32889
THURNAUER, M. C. ..... N91-32752
TIESZEN, S. R. ..... N91-32194
TILMANT, J. ..... N91-32314
TIMMINS, P. ..... N91-32418
N91-32419
TIRRES, LIZET ..... N91-32077
TITI, E. S. ..... N91-32452
TIWARI, SURENDRA N. ..... N91-32078
N91-32462
TOERNES, JOHN AA ..... N91-32148
N91-32188
TOET, A. ..... N91-32753
N91-32812
TOKITA, T. ..... N91-32476
TOLMIE, D. E. ..... N91-32855
N91-32856
TOMMASO, G. ..... N91-32365
TONG, CHARLES ..... N91-32845
TONN, B. ..... N91-32870
TOOMRE, JURI ..... N91-32675
TORGERSEN, T. ..... N91-32594
TORVIK, PETER J. ..... N91-32130
TOWNSEND, G. C. ..... N91-32351
TREDICI, THOMAS J. ..... N91-32754
TRIMBLE, VIRGINIA ..... N91-33030
TRIPOLI, GREGORY J. ..... N91-32670
TRUCANO, T. G. ..... N91-32233
TUCKER, D. S. ..... N91-32185
TURNBULL, A. ..... N91-32202

## U

UGOLINI, D. ..... N91-32842
UHL, MARY A. ..... N91-32692
UMAN, MARTIN A. ..... N91-32629
N91-32734
N91-32736
UMAR, A. S. ..... N91-32881
UMEDA, YOSHIKUNI ..... N91-32052
UMEZAWA, A. ..... N91-32969
N91-32989
UMLAND, JEFFREY W. ..... N91-32290
UNDERWOOD, J. H. ..... N91-32518
USADI, A. ..... N91-32592

## V

VAIDYANATHAN, H. ..... N91-32555
VAIRAVAMURTHY, A. ..... N91-32585
VALINO, L. ..... N91-32448
VANDENBERG, B. ..... N91-32444
VANDERVOORT, K. G. ..... N91-32989

VANDERVORST, A. ..... N91-32243
VANHECKE, B. ..... N91-32310
VANHOENACKER, D. ..... N91-32243
VANNUCCI, RAYMOND D. ..... N91-32230
VANTREES, STEPHEN P. ..... N91-32115
VARGAS-ABURTO, CARLOS ..... N91-32237
VARINEAU, P. T. ..... N91-32189
VAUGHAN, OTHA H., JR. ..... N91-32720
VAWTER, G. A. ..... N91-32406
VEBER, G. ..... N91-32437
VELEV, OMOURTAG A. ..... N91-32558
VENTURIN, J.-L. ..... N91-32298
VENTURINI, E. L. ..... N91-32962
VERMEIREN, J. ..... N91-32296
VETTIER, C. ..... N91-32920
VICCARO, P. J. ..... N91-32928
VILNROTTER, V. A. ..... N91-32263
VINCENT, DAYTON G. ..... N91-32691
VINOKUR, V. M. ..... N91-32967
N91-32968
VINOKUR, VALERIE V. ..... N91-32988
VISCO, S. J. ..... N91-32404
VOLZ, RICHARD A. ..... N91-32825
VONNEGUT, BERNARD ..... N91-32720
VORGUCIC, A. ..... N91-32634
N91-32698
VOSTEEN, JAMES R. ..... N91-32722
VOSTEEN, WILLIAM E. ..... N91-32722
VROLYK, J. J. ..... N91-32560

## W

WADA, ATSUSHI ..... N91-32654
WADA, YASUHIRO ..... N91-32035
WAGH, A. S. ..... N91-32232
WAGNER, C. ..... N91-32870
WAGNER, DAVID ANTHONY ..... N91-32517
WAKU, HIROSHI ..... N91-32043
WALDROP, RAYMOND S. ..... N91-32825
WALI, K. C. ..... N91-32895
WALKER, D. W. ..... N91-32456
WALKO, LAWRENCE C. ..... N91-32737
WALL, F. D. ..... N91-32219
WALL, J. J. ..... N91-32387
WALLACE, P. L. ..... N91-32208
WALLCRAFT, A. J. ..... N91-32746
WALLER, R. A. ..... N91-32590
WALLSTEN, T. S. ..... N91-32757
WALSH, S. J. ..... N91-32740
WALTER, C. E. ..... N91-32911
WALTON, J. J. ..... N91-32588
WANG, H. H. ..... N91-32969
WANG, SHOUPING ..... N91-32661
WANG, TAYLOR G. ..... N91-32240
WANG, ZHIYU ..... N91-32752
WANGEN, L. E. ..... N91-32189
WARDWELL, DOUGLAS A. ..... N91-32070
WARREN, A. J. ..... N91-32681
WAS, G. S. ..... N91-32981
WATANABE, K. ..... N91-32592
WATANABE, TSUGUHIRO ..... N91-32934
WATERBURY, S. ..... N91-32369
WATSON, ANDREW ..... N91-32798
WATSON, ANDREW I. ..... N91-32703
WAWERSIK, W. R. ..... N91-32199
WEBER, H. W. ..... N91-32987
WEBER, M. ..... N91-32620
WEBER, M. J. ..... N91-32985
WEBER, S. ..... N91-32752
WEEMS, J. ..... N91-32704
WEINER, STEPHEN P. ..... N91-32166
WEINZAPFEL, C. L. ..... N91-32483
WEISS, P. ..... N91-32292
WELCH, D. O. ..... N91-32972
WELCH, JEANNE A. ..... N91-32470
WELLER, R. ..... N91-32273
WELLS, DENNIS L. ..... N91-32508
WELP, U. ..... N91-32967
N91-32968
N91-32989
WENDELL, L. L. ..... N91-32577
WENG, HENGYI ..... N91-32672
WENTZ, FRANK J. ..... N91-32684
WENZEL, T. ..... N91-32232
WESCOTT, C. ..... N91-32325
WEST, C. D. ..... N91-32891
WEST, R. N. ..... N91-32973
WEST, THOMAS W. ..... N91-32795
WESTBROOK, C. K. ..... N91-32197
WHALLEY, MATTHEW S. ..... N91-32145
WHEASLER, ROBERT A. ..... N91-32136
WHEELER, JAMES R. ..... N91-32565
WHITAKER, MIKE ..... N91-32626
N91-32628
WHITE, A. R. ..... N91-32888
WHITE, B. ..... N91-32910
WHITE, C. W. ..... N91-32960
WHITE, D. H. ..... N91-32904
WHITE, M. ..... N91-32317
WHITE, TERRY F. ..... N91-33013
WHITE, VIRGINIA ..... N91-32128
WHITFIELD, R. G. ..... N91-32757
N91-32860
WHITING, CHARLES W. ..... N91-32776
WHYTE, WAYNE A., JR. ..... N91-32247
N91-32287
WICHMANN, B. A. ..... N91-32809
N91-32810
WIESERMAN, W. R. ..... N91-32412
WIJBENGA, A. ..... N91-32813
WILCOX, S. ..... N91-32575
WILES, K. ..... N91-32717
N91-32718
WILKE, G. D. ..... N91-32227
N91-32985
WILLE, L. T. ..... N91-32958
WILSON, ROBERT W. ..... N91-33022
WINDLEY, P. ..... N91-32853
WINDMAR, DAN ..... N91-32655
WINKLER, R. L. ..... N91-32757
WINNERL, J. ..... N91-32394
WINTER, CARL-JOCHEN ..... N91-32568
N91-32581
N91-33001
WINTER, JERRY M. ..... N91-32569
WISE, J. L. ..... N91-32233
WITHERELL, M. D. ..... N91-32518
WITTERS, J. ..... N91-32295
WITTIG, THIES ..... N91-32997
WOJCIK, LEONARD A. ..... N91-32119
WOLFF, SIDNEY ..... N91-33020
WONG, C. P. C. ..... N91-32952
WOOD, L. ..... N91-32151
WOODS, P. G. ..... N91-32482
WORLEY, P. H. ..... N91-32456
WRIGHT, PAT ..... N91-32667
WU, J. S. ..... N91-32881
WU, JIANTIAN ..... N91-32288
WU, XIAO-LIN ..... N91-32964
WU, YUEH-SHIOU ..... N91-32127
WULF, F. ..... N91-32354
N91-32355
WYSE, N. ..... N91-32704

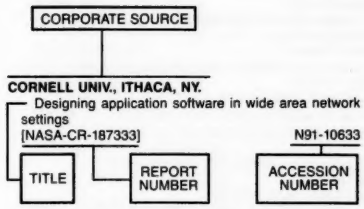
## Y

YACOUB, ZIAD ..... N91-32734
YAMADA, HITOSHI ..... N91-32053
YAMADA, T. ..... N91-32328
YAMAMOTO, KIYOSHI ..... N91-32062
YAMAMOTO, SATORU ..... N91-32063
YAMAMOTO, YUKIMITSU ..... N91-32034
YAMAUCHI, T. ..... N91-32956
YAMAWAKI, RURIKO ..... N91-32069
YAN, T.-Y. ..... N91-32259
YAN, Y. T. ..... N91-32906
YANG, Z. ..... N91-32460
YASUHARA, MICHIRU ..... N91-32040
YATES, G. J. ..... N91-32407
YEE, J. H. ..... N91-32286
YOES, CISSY ..... N91-32824
YOUNG, ELIZABETH ..... N91-32111
YOUNG, JOHN ..... N91-32777
N91-32778
N91-32790
YOUNG, L. E. ..... N91-32262
YOUNG, P. E. ..... N91-32951
YOUNKER, L. W. ..... N91-33053
YOUNKIN, J. R. ..... N91-32513
YOUSSEF, A. ..... N91-32330
YUN, W. B. ..... N91-32928
YUZUBARA, T. ..... N91-32476

## Z

ZAGARINO, P. ..... N91-32407
ZAGRODNIK, JEFFREY P. ..... N91-32564
ZAHN, REINHOLD L. ..... N91-32393
ZAHOPOULOS, C. ..... N91-32255
ZAMANI, N. ..... N91-32327
ZAMBRA, A. ..... N91-32329
ZAWODZINSKI, T. A. ..... N91-32573
ZAZWORSKY, R. M. ..... N91-32157
N91-32490
ZEDALIS, M. S. ..... N91-32200
ZEE, RALPH H. ..... N91-32497
ZHONG, S. ..... N91-32743
ZHOU, JUN ..... N91-32540
ZHU, LIE ..... N91-32595
ZIMMERMAN, ALBERT H. ..... N91-32554
ZIMMERMAN, T. ..... N91-32414
ZIPSER, EDWARD J. ..... N91-32685
ZOUTENDYK, J. A. ..... N91-32347
ZUMWALT, G. W. ..... N91-32284
ZUZEK, JOHN E. ..... N91-32287

## Typical Corporate Source Index Listing




Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

## A


**ABB HAFO A.B., JAERFAELLA (SWEDEN).**
Design and manufacture of space ASICs today and tomorrow: Promises and problems N91-32299
Analog CMOS/SOS in radiative environments N91-32350
ABB Hafo's ESA approved capability domain for CMOS/SOS ASICs N91-32388

**ACADEMIA SINICA, BEIJING (CHINA).**
The effects of sulfate and soot in smoke on atmospheric extinction N91-32539
An iterative method for obtaining the optimum lightning location on a spherical surface N91-32709

**ACADEMIA SINICA, HEFEI (CHINA).**
A lidar equipped with photon counter for measuring stratospheric aerosols N91-32540

**ACADEMY OF SCIENCES (USSR), MOSCOW.**
Optimal parameters of leader development in lightning N91-32723
Experimental modelling of lightning interaction phenomena with a free potential conducting objects N91-32729

**ACOUSTICAL SOCIETY OF AMERICA, NEW YORK, NY.**
US TAG for ISO/TC108 mechanical vibration and shock: Minutes of the accredited standards committee on mechanical shock and vibration, S2
[AD-A239536] N91-32521

**ADMIRALTY RESEARCH ESTABLISHMENT, GOSPORT (ENGLAND).**
Component local velocities of a ship along a defined axis
[ARE-TM(UHR)-91305] N91-32424

**ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, NEUILLY-SUR-SEINE (FRANCE).**
Aerodynamics of combat aircraft controls and of ground effects
[AGARD-AR-271] N91-32082
Propagation Limitations for Systems Using Band-Spreading
[AGARD-LS-172] N91-32241
Appraisal of the Suitability of Turbulence Models in Flow Calculations
[AGARD-AR-291] N91-32443
Motion Sickness: Significance in Aerospace Operations and Prophylaxis
[AGARD-LS-175] N91-32759

**AERONAUTICAL RADIO, INC., ANNAPOLIS, MD.**
Digitized voice trials N91-32103

**AERONAUTICAL RADIO, INC., WASHINGTON, DC.**
The FAA/ARINC initial implementation of AMSS N91-32112
Evaluation of oceanic flight deck workload and error reductions through the use of data communications N91-32128

**AERONAUTICAL RESEARCH LABS., MELBOURNE (AUSTRALIA).**
Time-frequency domain analysis of helicopter transmission vibration
[ARL-PROP-R-180] N91-32146

**AEROSPACE CORP., EL SEGUNDO, CA.**
The effects of platinum on nickel electrodes in the nickel hydrogen cell N91-32554

**AEROSPACE CORP., LOS ANGELES, CA.**
Step voltage analysis for the catenoid lightning protection system N91-32623

**AEROSPACE ENGINEERING AND RESEARCH ASSOCIATES, INC., LANDOVER, MD.**
Automatic Dependent Surveillance (ADS) Program summary N91-32094

**AEROSPATIALE, CANNES (FRANCE).**
Preparing electronics quality for the next century N91-32382

**AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OH.**
High current pulse testing for ground rod integrity N91-32737

**AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MA.**
A survey of laser lightning rod techniques N91-32645
Predicting cloud-to-ground lightning with neural networks N91-32646

**AIR FORCE HUMAN RESOURCES LAB., WILLIAMS AFB, AZ.**
Aircrew part-task training research and development in the 1980s: Lessons learned
[AD-A239456] N91-32773

**AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OH.**
On the maximum range of flying wings
[AD-A229487] N91-32130
Cost effectiveness of two versus three levels of maintenance for turbine engines in the Air Force inventory
[AD-A229622] N91-32137
Development of a handbook for configuration managers with applications for the program/system in full-scale development
[AD-A229617] N91-32993
Identification of essential success factors for an electronic master publication library
[AD-A229624] N91-33004

**AIR NAVIGATION TECHNICAL SERVICE, PARIS (FRANCE).**
French SATCOM program and related international activities N91-32102

**AIR TRANSPORT ASSOCIATION OF AMERICA, WASHINGTON, DC.**
Satellite surveillance and communications airline benefits: The telephone myth N91-32124

**AIRBORNE RESEARCH ASSOCIATES, WESTON, MA.**
Thunderstorm detection and warning system atmospheric potential monitor N91-32608

**AKRON UNIV., OH.**
The effect of chemical additives on the synthesis of ethanol
[DE91-016586] N91-32192
Finite element implementation of state variable-based viscoplasticity models
[NASA-CR-187212] N91-32523
Dynamics of charge-transfer excited states relevant to photochemical energy conversion
[DE91-017710] N91-32578

**ALABAMA UNIV., HUNTSVILLE.**
Polarization effects, tasks 3 and 4
[NASA-CR-184219] N91-32221
Microgravity liquid propellant management
[NASA-CR-184238] N91-32236
Advanced visualization techniques N91-32669
Monitoring, analyzing, and modeling global climate N91-32689

**ALASKA UNIV., FAIRBANKS.**
A study of the magnetosphere-ionosphere coupling processes N91-32595

**ALCATEL ESPACE, TOULOUSE (FRANCE).**
Digital ASIC design for space applications N91-32300
Qualification strategy for multi-chip packaging for space applications N91-32312
Surface mount technology on PCBs at Alcatel Espace N91-32326

**ALLIED-SIGNAL AEROSPACE CO., KANSAS CITY, MO.**
Surface modification of high-strength reinforcing fibers by plasma treatment
[DE91-016481] N91-32226
Numerical simulation of a laser welding process
[DE91-016454] N91-32500

**ALLIED-SIGNAL CORP., MORRISTOWN, NJ.**
Effect of thermal exposure, forming, and welding on high-temperature, dispersion-strengthened aluminum alloy: Al-8Fe-1V-2Si
[NASA-CR-187575] N91-32200

**AMERICAN ASTRONOMICAL SOCIETY, WASHINGTON, DC.**
Status of the profession N91-33031

**AMERICAN METEOROLOGICAL SOCIETY, BOSTON, MA.**
Study on observational systems: A review of meteorological and oceanographic education in observational techniques and the relationship to national facilities and needs
[PB91-198168] N91-32739

**AMES LAB., IA.**
Alleviation of interferences and reduction of sample memory in inductively coupled plasma mass spectrometry
[DE91-016399] N91-32943
Single vortex motion and elementary pinning force in SNIS Josephson junctions
[DE91-016160] N91-32963
Experimental studies of long-range atomic H motion and desorption in hydrogenated amorphous silicon and germanium
[DE91-016161] N91-32964

**AMSTERDAM UNIV. (NETHERLANDS).**
Assessment of drug effectiveness N91-32768

**ANALYTICAL SERVICES AND MATERIALS, INC., HAMPTON, VA.**
Simplified micromechanical equations for thermal residual stress analysis of coated fiber composites
[NASA-CR-187599] N91-32527

**ANT NACHRICHTENTECHNIK, BACKNANG (GERMANY, F.R.).**
Selection strategy and reliability assessment for SILEX-communication laser diodes N91-32306
Is the ESA/SCC screening technique more efficient than the MIL specifications? N91-32392
Specification, procurement and testing of passivated microwave semiconductor chips for space applications N91-32393

**ARGE-DETECON, BONN (GERMANY, F.R.).**
Experiences with components in the DFS-project: Seen from a customer's point of view N91-32366

**ARGONNE NATIONAL LAB., IDAHO FALLS, ID.**
Hadronic photons and collider diffractive physics
[DE91-016514] N91-32888

**ARGONNE NATIONAL LAB., IL.**
Electronic transport properties in copper oxides
[DE91-018182] N91-32213
Materials qualification technology for ceramic cross-flow filters
[DE91-017715] N91-32232
Magneto-optical record media
[DE91-017838] N91-32476
Tribological behavior of silver films prepared on ceramic surfaces by ion-beam-assisted deposition
[DE91-017306] N91-32505
Effects of oxygen enrichment and fuel emulsification on diesel engine performance and emissions
[DE91-016520] N91-32506
Parallel scalability of the spectral transform method
[DE91-017991] N91-32744
The role of spin chemistry in the primary events of photosynthesis
[DE91-017301] N91-32752
Assessing the risk of chronic lung injury attributable to long-term ozone exposure
[DE91-016814] N91-32757

Performance of a benchmark implementation of the Van Slyke and Wets algorithm for stochastic programs on the Alliant FX/8
[DE91-016515] N91-32833

Parallel computing and domain decomposition
[DE91-017967] N91-32854

Evaluation of knowledge-based system development tools
[DE91-017241] N91-32860

Coherent hard x ray focusing optics and applications
[DE91-017968] N91-32928

Ion beams in high-temperature superconductivity research
[DE91-016521] N91-32965

Critical currents in melt-textured YBa2Cu3O(x)
[DE91-016523] N91-32966

Scaling behavior of the fluctuations in magnetization and conductivity of untwinned YBa2Cu3O(7-delta)
[DE91-016524] N91-32967

Flux pinning by planar defects in single crystal YBa2Cu3O(7-delta)
[DE91-016525] N91-32968

Magnetic relaxation of the organic superconductor kappa-(BEDT-TTF)2Cu(N(CN)2)Br
[DE91-016528] N91-32969

X ray dichroism and Faraday effect studies in ordered and disordered Fe3Pt
[DE91-017305] N91-32974

A simple sagittal focusing crystal which utilizes a bimetallic strip
[DE91-017324] N91-32975

Application of a thermal spike model to experimental ion-induced grain growth data
[DE91-017320] N91-32981

Cryogenic cooling of x ray crystals using porous matrix
[DE91-017322] N91-32982

Magnetic relaxation in a single crystal of YBa2Cu3O(x)
[DE91-017963] N91-32986

Critical currents in sputtered YBCO films
[DE91-017976] N91-32987

Flux dynamics in high-Tc superconductors
[DE91-017977] N91-32988

Anisotropy in the a-b plane of normal and superconducting YBa2Cu3O(x)
[DE91-017997] N91-32989

**ARIZONA STATE UNIV., TEMPE.**

Dynamics modeling and control of a flexible robot arm
N91-32495

Particulate models of photosynthesis
[DE91-016842] N91-32751

Photoinitiated electron transfer in multi-chromophoric species: Synthetic tetrads and pentads featuring diquinone moieties
[DE91-017413] N91-32896

**ARIZONA UNIV., TUCSON.**

The spatial variations of lightning during small Florida thunderstorms N91-32711

Atmospheres of comets: Gas dynamic models and inference of kinematic parameters N91-33036

**ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, WATERVLIET, NY.**

Load-line displacements for three-point bend J tests using bottom surface displacements
[AD-A229634] N91-32518

**ARMY MISSILE COMMAND, REDSTONE ARSENAL, AL.**

A simulated lightning effects test facility for testing live and inert missiles and components N91-32725

**ARMY NATICK RESEARCH AND DEVELOPMENT COMMAND, MA.**

Human analogue models for computer-aided design and engineering applications
[AD-A229520] N91-32775

**ASSOCIATION AERONAUTIQUE ET ASTRONAUTIQUE DE FRANCE, PARIS.**

Aerodynamic computation post processing tools
[AAAF-NT-89-20] N91-32073

**ATLANTIC RESEARCH CORP., ARLINGTON, VA.**

An assessment of tailoring of lightning protection design requirements for a composite wing structure on a metallic aircraft N91-32641

**ATMOSPHERIC RESEARCH SYSTEMS, INC., PALM BAY, FL.**

The effect of the Earth's oblate spheroid shape on the accuracy of a time-of-arrival lightning ground strike locating system N91-32706

**AUBURN UNIV., AL.**

A study of fracture mechanisms in ATD roller bearing
[NASA-CR-184200] N91-32497

## B

**BELEIDSCOMMISSIE REMOTE SENSING, DELFT (NETHERLANDS).**

An optical multichannel analyser based large volume reflectometer
[BCRS-90-37] N91-32469

**BOEING AEROSPACE AND ELECTRONICS CO., SEATTLE, WA.**

Advanced thermoplastic resins, phase 2
[NASA-CR-187548] N91-32231

**BOEING AEROSPACE CO., COCOA BEACH, FL.**

Launch pad lightning protection effectiveness
N91-32627

**BOEING CO., SEATTLE, WA.**

An example of requirements for Advanced Subsonic Civil Transport (ASCT) flight control system using structured techniques
[NASA-CR-187526] N91-32132

**BOEING COMMERCIAL AIRPLANE CO., SEATTLE, WA.**

Communications needs of the future air-ground interface N91-32125

**BROOKHAVEN NATIONAL LAB., UPTON, NY.**

A nuclear thermal rocket engine design based on the particle bed reactor suitable for a Mars mission
[DE91-016898] N91-32160

Photon stimulated desorption from aluminum and stainless steel
[DE91-017007] N91-32211

Sampling of atmospheric carbonyl compounds for determination by liquid chromatography after 2,4-dinitrophenylhydrazine labelling
[DE91-015842] N91-32585

Liquid and solid Ga and Bi studies with a variable energy positron beam
[DE91-016910] N91-32889

High-energy synchrotron radiation x ray microscopy: Present status and future prospects
[DE91-016894] N91-32893

Ion clearing and photoelectron production in the 200 MeV SXLS ring
[DE91-017156] N91-32907

Soft x ray magnetic scattering study of thin films and multilayers
[DE91-017472] N91-32920

Interaction of InGa liquid alloy coolant with gold coated optical materials
[DE91-017480] N91-32927

Magnetically measured irreversibility temperatures in superconducting oxides and alloys
[DE91-016895] N91-32972

Specular and diffuse scattering studies of multilayer interfaces
[DE91-016893] N91-32978

**BROWN UNIV., PROVIDENCE, RI.**

Analytical and numerical studies of fracture and fatigue in ceramic materials N91-32516

**BUREAU OF MINES, WASHINGTON, DC.**

Flywheel-powered shuttle car
[PB91-200543] N91-32499

Mining technology for lunar resource utilization
[PB91-201020] N91-33044

## C

**CALIFORNIA UNIV., BERKELEY.**

Self-generated stochastic heating in an RF discharge
[DE91-017404] N91-32948

Particle astrophysics N91-33024

**CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.**

Equations of state for solid NaCl-KCl and liquid NaCl-KCl-H2O
[DE91-016980] N91-32195

Reaction sintering of ZnO-Al2O3
[DE91-016254] N91-32210

Current status of solid-state lithium batteries employing solid redox polymerization cathodes
[DE91-016988] N91-32404

Numerical study of Stokes flows with suspended particles
[DE91-017011] N91-32455

A guidebook for the control of summer heat islands
[DE91-016246] N91-32586

Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root
[DE91-016255] N91-32749

Analysis of polarization properties of shallow metallic gratings by an extended Rayleigh-Fano theory
[DE91-016982] N91-32835

Graph theory and the Virasoro master equation
[DE91-016432] N91-32866

Crossed beams studies of nonadiabatic collision dynamics
[DE91-016250] N91-32879

Effective theories and thresholds in particle physics
[DE91-016257] N91-32880

Emittance variations in current-amplifying ion induction linacs
[DE91-016266] N91-32909

Circular Intensity Differential Scattering (CIDS) measurements in the soft x ray region of the spectrum (approximately 16 eV to 500 eV)
[DE91-016429] N91-32915

Oxygen ordered superstructures and domain formation in YBa2Cu3O(7-x)
[DE90-015633] N91-32958

Thermodynamics of combustion in an enclosure
[DE91-016430] N91-32992

**CALIFORNIA UNIV., DAVIS.**

Use of satellite data and modeling to assess the influence of stratospheric processes on the troposphere
N91-32673

The formal verification of generic interpreters
[NASA-CR-4403] N91-32853

**CALIFORNIA UNIV., IRVINE.**

Benefits to the nation from astronomy and astrophysics N91-33030

**CALIFORNIA UNIV., LOS ANGELES.**

Control design variable linking for optimization of structural/control systems N91-32144

Multiheteromacrocycles that complex metal ions
[DE91-016292] N91-32205

**CALIFORNIA UNIV., SANTA BARBARA.**

Bifurcations and patterns in non-linear dissipative systems
[DE91-017402] N91-32984

**CALIFORNIA UNIV., SANTA CRUZ.**

UV-optical from space N91-33021

**CARNEGIE-MELLON UNIV., PITTSBURGH, PA.**

A unified motion planning approach for redundant and nonredundant manipulators with actuator constraints
N91-32494

**CASE WESTERN RESERVE UNIV., CLEVELAND, OH.**

I-BIEM calculations of the frequency dispersion and AC current distribution at disk and ring-disk electrodes
N91-32559

**CATHOLIC UNIV. OF AMERICA, WASHINGTON, DC.**

Temporal and spectral features of wall pressure fluctuations beneath a turbulent boundary layer
N91-32461

**CENTRE D'ESSAIS AERONAUTIQUE TOULOUSE (FRANCE).**

Influence of configuration effects on multiple burst simulation testing N91-32631

**CENTRE D'ETUDES DE GRAMAT (FRANCE).**

A real scale simulator for high frequency LEMP
N91-32700

A theoretical analysis of the electromagnetic environment of the AS330 super Puma helicopter external and internal coupling N91-32701

**CENTRE D'ETUDES ET DE RECHERCHES, TOULOUSE (FRANCE).**

CECIL: Collaboration between companies and research agencies in heavy ion test of spacecraft microelectronics
N91-32348

Single event effects by protons on low Earth orbits: A problem for European manned space missions
N91-32349

Calculation of turbulent compressible flows
N91-32445

**CENTRE DE RECHERCHES EN PHYSIQUE DE L'ENVIRONNEMENT, ISSY-LES-MOULINEAUX (FRANCE).**

New technologies for integrating thermal control, and radiation protection in hybrid technology N91-32330

**CENTRE DE RECHERCHES SCIENTIFIQUES ET TECHNIQUES DE L'INDUSTRIE DES FABRICATIONS METALLIQUES, BRUSSELS (BELGIUM).**

High speed welding used in building metallic structures
[CRIF-MT-180] N91-32496

**CENTRE NATIONAL D'ETUDES DES TELECOMMUNICATIONS, LANNION (FRANCE).**

A survey of the parasitic effects and degradation mechanisms affecting the GaAs FET-based IC's: The first step for a technological evaluation N91-32304

Direct influence of chip design and material composition on GaAs/GaAlAs laser diodes reliability N91-32307

**CENTRE NATIONAL D'ETUDES SPATIALES, TOULOUSE (FRANCE).**

CNES activities on ASIC N91-32298

Radiation sensitivity of power MOSFETS N91-32344

Trends in latch-up sensitivity N91-32345

Evaluation of FPGAs N91-32361

Summary of EEE component anomalies encountered in the SPOT line of Earth observation satellites and lessons derived therefrom for future generations N91-32367

**CENTRE SCIENTIFIQUE ET TECHNIQUE DU BATIMENT, SAINT-MARTIN-D'HERES (FRANCE).**
Near ground sound propagation in wind
[CSTB-2-89-003-4] N91-32871
**CESI, MILAN (ITALY).**
Evaluation of the damages caused by lightning current flowing through bearings N91-32632
**CHICAGO UNIV., IL.**
Theory and laboratory astrophysics N91-33025
Solar astronomy N91-33026
**CINCINNATI UNIV., OH.**
On the nonlinear response of minor atmospheric species to linear gravity waves N91-32593
**CITY COLL. OF THE CITY UNIV. OF NEW YORK, NY.**
Studies in premixed combustion
[DE91-016964] N91-32198
**CIVIL AVIATION AUTHORITY, CANBERRA (AUSTRALIA).**
Australian experiments in Automatic Dependent Surveillance (ADS) including the Pacific Engineering Trials (PET) N91-32101
**COLORADO UNIV., BOULDER.**
A study of geographically correlated orbit errors for Topex-incorporating GPS data N91-32154
Laboratory and theoretical models of planetary-scale instabilities and waves N91-32675
Policy opportunities N91-33029
**COLUMBIA UNIV., NEW YORK, NY.**
Photogenerated carrier-induced reactions on semiconductor surfaces
[DE91-017550] N91-32416
**COMMISSARIAT A L'ENERGIE ATOMIQUE, BRUYERES-LE-CHATEL (FRANCE).**
Single event upset sensitivity of a SRAM: An overview from testing procedures to device hardening (theme 2) N91-32346
**COMMISSARIAT A L'ENERGIE ATOMIQUE, GIF-SUR-YVETTE (FRANCE).**
Measurements of proton upset induced in CMOS devices: Synthesis of CEA studies N91-32356
**COMMUNICATIONS AND WEATHER RESEARCH FOUNDATION, JACKSONVILLE, FL.**
Guidelines for a proposed lightning protection policy of a golf association or tournament sponsor N91-32735
**COMMUNICATIONS SATELLITE CORP., CLARKSBURG, MD.**
Physical and chemical analysis of a Ni/H2 cell N91-32555
**COMMUNICATIONS SATELLITE CORP., WASHINGTON, DC.**
Operational SATCOM: Moving from trials to service N91-32111
**COMPAGNIE D'ELECTRONIQUE ET DE PIEZO-ELECTRICITE, ARGENTEUIL (FRANCE).**
Qualification status of hybrid crystal oscillators style OTO 16S for space application N91-32322
**COMPONENTS TECHNOLOGY INST., INC., HUNTSVILLE, AL.**
The history of space quality EEE parts in the United States N91-32370
**COMPUTER RESOURCE MANAGEMENT, INC., ATLANTIC CITY, NJ.**
Implementation of the FAA research and development electromagnetic database N91-32715
**COMPUTER TECHNOLOGY ASSOCIATES, INC., MCKEE CITY, NJ.**
Aeronautical Mobile Satellite Service (AMSS) message and voice access request transit delay N91-32107
A model human engineering approach to the development of regulatory standards for digital communication technologies: Defining safety from a human-machine systems perspective N91-32126
**CONNECTICUT UNIV., GROTON.**
Helium isotopic constraints on terrestrial degassing and the transcrustal transport of mantle methane
[PB91-206458] N91-32594
**CONSIGLIO NAZIONALE DELLE RICERCHE, FLORENCE (ITALY).**
Polar stratospheric cloud measurements by means of depolarization lidar in the Antarctic N91-32537
**CONSTRUCCIONES AERONAUTICAS S.A., MADRID (SPAIN).**
Tests of salinic clouds in test tube of the 7075 carbon fiber with metal mesh (Airbus 330/340)
[INFORME-I-520/90] N91-32175
Resistance of perished paints to Skydrol
[INFORME-I-536/90] N91-32223
**CRANFIELD INST. OF TECH., BEDFORD (ENGLAND).**
Composite-faced sandwich construction for primary spacecraft structures N91-32170
An investigation into the potential use of psychometric instruments for the selection of firearms officers
[CRANFIELD-AERO-9108] N91-32772

## D

**DASSAULT (E. M.) CO., SAINT CLOUD (FRANCE).**
Electromagnetic topology: Characterization of internal electromagnetic coupling N91-32699
**DEFENCE AND CIVIL INST. OF ENVIRONMENTAL MEDICINE, NORTH YORK (ONTARIO).**
Signs and symptoms of motion sickness and its basic nature N91-32760
Space sickness N91-32764
Simulator sickness N91-32765
**DEFENSE LOGISTICS AGENCY, ALEXANDRIA, VA.**
Defense Logistic Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 1: Agency-wide plan IRM summary information: Agency
[PB91-204529] N91-33007
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 2: Individual organizational IRM plans: Organizations
[PB91-204537] N91-33008
Defense Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 3: Information systems/projects/programs/acquisitions: Catalogue
[PB91-204545] N91-33009
Defence Logistics Agency (DLA) long-range Information Resources Management (IRM) plan, FY 1991 - FY 1997. Volume 4: Reference information: Reference
[PB91-204552] N91-33010
**DELAWARE UNIV., NEWARK.**
Particle theory and cosmology
[DE91-017730] N91-33041
**DEPARTMENT OF DEFENSE, WASHINGTON, DC.**
Federal radionavigation plan, 1990
[PB91-190868] N91-32091
NASA/DoD aerospace knowledge diffusion research project: Phase 3 academic library respondents including frequency distributions
[NASA-TM-104095] N91-33013
**DEPARTMENT OF ENERGY, OAK RIDGE, TN.**
Office of Industrial Technologies research in progress
[DE91-014180] N91-32571
Environment, Safety and Health Thesaurus/Dictionary
[DE91-013428] N91-33012
**DEPARTMENT OF ENERGY, WASHINGTON, DC.**
Office of Industrial Technologies research in progress
[DE91-014180] N91-32571
**DEPARTMENT OF THE NAVY, WASHINGTON, DC.**
Silver lined ceramic vessel and method of preparation
[AD-D014953] N91-32224
Planar gallium arsenide NPNP microwave switch
[AD-D014948] N91-32398
Non-invasive pressure measuring device and method
[AD-D014949] N91-32470
Resistive gate magnetic field sensor
[AD-D014952] N91-32471
**DEPARTMENT OF TRANSPORTATION, CAMBRIDGE, MA.**
Federal radionavigation plan, 1990
[PB91-190868] N91-32091
Vehicle Animation Software (VAS) to animate results obtained from vehicle handling and rollover simulations and tests
[PB91-194142] N91-32832
**DEPARTMENT OF TRANSPORTATION, WASHINGTON, DC.**
Federal radionavigation plan, 1990
[PB91-190868] N91-32091
**DESERT RESEARCH INST., RENO, NV.**
Laboratory and field studies of stratospheric aerosols: Phase changes under high supersaturation N91-32533
**DETROIT DIESEL ALLISON, INDIANAPOLIS, IN.**
Investigation of advanced counterrotation blade configuration concepts for high speed turboprop systems. Task 3: Advanced fan section grid generator final report and computer program user's manual
[NASA-CR-187129] N91-32138
**DEUTSCHE AIRBUS G.M.B.H., BREMEN (GERMANY, F.R.).**
Protection of electrical and electronic equipment against lightning indirect effects on the Airbus A340 wing N91-32613
**DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK (GERMANY, F.R.).**
Determination of aerodynamic characteristics from ATTAS flight data gathering for ground-based simulator
[DLR-FB-91-15] N91-32076
**DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, COLOGNE (GERMANY, F.R.).**
Flight mechanical model for performance calculations and interactions between flight vehicle and ramjet in regard to the flight orbit
[DLR-FB-91-03] N91-32131
Thermodynamic flow description of a ramjet for determination of engine forces and moments
[DLR-FB-91-02] N91-32139
Photobiological investigations on spores of Streptomyces griseus
[DLR-FB-91-14] N91-32748
**DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, GOETTINGEN (GERMANY, F.R.).**
Aeroelastic flutter prevention in gliders and small aircraft
[DLR-MITT-91-03] N91-32142
**DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, HAMBURG (GERMANY, F.R.).**
Study of the predictive validity of a psychological selection procedure for air-traffic controllers based on training criteria
[DLR-FB-91-11] N91-32090
**DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, LAMPOLDSHAUSEN (GERMANY, F.R.).**
Comparison of kinetic, equilibrium, and frozen rocket expansion obtained at different propulsive parameters for launcher and spacecraft engines
[DLR-MITT-91-02] N91-32159
**DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN (GERMANY, F.R.).**
Methods for the automatic de-aliasing of the Doppler velocity of a weather radar
[DLR-FB-91-08] N91-32249
Numerical simulation of turbulent convection over wavy surfaces
[DLR-FB-91-12] N91-32439
Model calculations for a pushbroom stereo camera: The case of the Mars 94 High Resolution Stereo Camera (HRSC)
[DLR-FB-90-57] N91-32468
Automatic land-use classification using LANDSAT-5 thematic mapper data in a region of the Itzehoer Geest. An attempt to improve mapping by combination with panchromatic SPOT data
[DLR-FB-90-47] N91-32542
Parametric rectification of thematic mapper raw data
[DLR-FB-90-55] N91-32543
**DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, STUTTGART (GERMANY, F.R.).**
To what extent can Renewable Energy (RE) systems replace carbon-based fuels in the next 15, 50, and 100 years? Eight answers
[DLR-MITT-91-04] N91-32568
Nature and technology: Energy technology, mankind, and nature in the 21st century
[DLR-MITT-91-05] N91-32581
Finiteness: On constraints of applied research
[DLR-MITT-91-06] N91-33001
**DEUTSCHE GEODAETISCHE KOMMISSION, MUNICH (GERMANY, F.R.).**
Examinations of the rational utilization of the Global Positioning System (GPS) in local networks
[SER-C-361] N91-32129
Integrated compensation of geodetic nets in point masses model
[SER-C-362] N91-32547
The 1980 equalization diagnosis of the German main triangulation network. 5: Neighborhood, conclusions
[SER-B-272-PT-2] N91-32548
**DEUTSCHER WETTERDIENST, OFFENBACH AM MAIN (GERMANY, F.R.).**
Turbulent energy exchange between atmosphere and surface layer. Methodology, measuring technical realizations, their limits, and possible uses
[ISBN-3-88148-263-6] N91-32596
**DIMENSIONS, SAINT AUBIN (FRANCE).**
Thunderstorm monitoring and lightning warning, operational applications of the Safir system N91-32619
**DUKE UNIV., DURHAM, NC.**
Calculation of unsteady linearized Euler flows in cascades using harmonically deforming grids
[NASA-CR-188916] N91-32442

## E

**EAGLE-PICHER INDUSTRIES, INC., JOPLIN, MO.**
Small capacity, low cost (Ni-H2) design concept for commercial, military, and higher-volume aerospace applications N91-32565
**EASTMAN KODAK CO., ROCHESTER, NY.**
Precision metering of microliter volumes of biological fluids in micro-gravity N91-32792
**EDGERTON, GERMESHAUSEN AND GRIER, INC., IDAHO FALLS, ID.**
Development of a spray-forming process for steel
[DE91-015812] N91-32218

**EG AND G ENERGY MEASUREMENTS, INC., GOLETA, CA.**
Performance evaluation of new large-area avalanche photodiodes for scintillation spectroscopy [DE91-017400] N91-32405
Optical diagnostics of mercuric iodide crystal growth [DE91-017396] N91-32983
**EG AND G ENERGY MEASUREMENTS, INC., PLEASANTON, CA.**
Measurement of modulation transfer function for four types of imaging elements used in fast cameras [DE91-017399] N91-32475
**ELECTRICAL RESEARCH ASSOCIATION, LEATHERHEAD (ENGLAND).**
Lightning induced currents in aircraft wiring using low level injection techniques N91-32694
**ELECTRICITY COUNCIL RESEARCH CENTRE, CAPENHURST (ENGLAND).**
Extension of and improvements to the ERDC low frequency magnetic direction finding system N91-32708
**ELECTRO MAGNETIC APPLICATIONS, INC., LAKEWOOD, CO.**
The effects of the exhaust plume on the lightning triggering conditions for launch vehicles N91-32656
Electron distribution functions in electric field environments N91-32726
Evaluating lightning hazards to building environments using explicit numerical solutions of Maxwell's equations N91-32733
**ELECTROMER CORP., BELMONT, CA.**
Circuit protection devices for transient suppression N91-32732
**EMA, MANSFIELD, TX.**
Analysis of rotorwash effects in helicopter mishaps [DOT/FAA/RD-90/17] N91-32086
**EMC SCIENCE CENTER, INC., WEST CONSHOHOCKEN, PA.**
Lightning testing at the subsystem level N91-32714
**EMEC CONSULTANTS, EXPORT, PA.**
Electrolytic production of oxygen from lunar resources N91-32550
**ENVIRONMENTAL PROTECTION AGENCY, RESEARCH TRIANGLE PARK, NC.**
Annular denuders for use in global climate and stratospheric measurements of acidic gases and particles N91-32531
Proceedings of 2nd US/FRG Workshop on Photochemical Ozone Problem and its Control [PB91-211847] N91-32583
**ENVIRONMENTAL RESEARCH INST. OF MICHIGAN, ANN ARBOR.**
Synthetic aperture radar imagery of airports and surrounding areas: Study of clutter at grazing angles and their polarimetric properties [NASA-CR-4398] N91-32088
**ERNO RAUMFAHRTTECHNIK G.M.B.H. BREMEN (GERMANY, F.R.).**
Rationales for the selection of a parts procurement system (coordinated versus centralized) from a prime contractor point of view N91-32371
**ESSEN UNIV. (GERMANY, F.R.).**
Europe 1993: The single European market and R and D policy at Krupp N91-32995
**EUROPEAN SPACE AGENCY, PARIS (FRANCE).**
Rosetta/CNSR: A comet-nucleus sample-return mission and system definition document [ESA-SP-1125] N91-32152
ESA Electronic Components Conference [ESA-SP-313] N91-32291
ESA software engineering standards, issue 2 [ESA-PSS-05-0-ISSUE-2] N91-32811
Indirect imaging through the atmosphere [ESA-TT-1115] N91-33034
**EUROPEAN SPACE AGENCY. EUROPEAN SPACE RESEARCH AND TECHNOLOGY CENTER, ESTEC, NOORDWIJK (NETHERLANDS).**
Guidelines for carbon and other advanced fibre prepreg procurement specifications [ESA-PSS-03-207-ISSUE-1] N91-32176
Adhesive bonding handbook for advanced structural materials [ESA-PSS-03-210-ISSUE-1] N91-32234
GaAs/Ge solar cell for space applications N91-32293
Spacecraft power system concerns regarding failure modes within complex integrated circuits and hybrid packages N91-32308
Test on opto couplers in the linear application considering temperature, radiation and Vce effects N91-32314
Test structures and measurement techniques for radiation hardening N91-32332
The pre-screening of large semiconductor memories for space application N91-32357
Radiation assessment of the INMOS transputer family N91-32358
ESA's component programme plan N91-32373
Capability approval programme for Microwave Hybrid Integrated Circuits (MHICS) [ESA-PSS-01-612-ISSUE-1] N91-32420
The crimping of high-reliability electrical connections [ESA-PSS-01-726-ISSUE-2] N91-32421
The repair and modification of printed-circuit board assemblies for space use [ESA-PSS-01-728-ISSUE-2] N91-32422
The physics and instrumentation of passive atmospheric sounding: A review of the methods of remote sensing of temperature and moisture in the Earth's lower atmosphere [ESA-STR-231] N91-32597

## F

**FEDERAL ARMED FORCES UNIV., MUNICH (GERMANY, F.R.)**
Characteristics of return stroke electric fields produced by lightning flashes at distances of 1 to 15 kilometers N91-32615
Simulation and measurement of melting effects on metal sheets caused by direct lightning strikes N91-32644
**FEDERAL AVIATION ADMINISTRATION, ATLANTA, GA.**
Designs for surge immunity in critical electronic facilities N91-32635
**FEDERAL AVIATION ADMINISTRATION, ATLANTIC CITY, NJ.**
Results of MLS/ILS comparison flight test at the Yuma MCAS, Arizona [DOT/FAA/CT-TN91/10] N91-32092
The First Annual International Satellite Surveillance and Communication Symposium [DOT/FAA/RD-91/21] N91-32093
Automatic dependent surveillance Pacific engineering trials N91-32099
Operational oceanic air traffic control using satellite data link: Initial implementation N91-32121
Satellite data link validation test plan [DOT/FAA/CT-TN91/6] N91-32282
Data Multiplexing Network (DMN), phase 3: Equipment Operational Test and Evaluation (OT&E)/Integration test plan [DOT/FAA/CT-TN91/24] N91-32283
**FEDERAL AVIATION ADMINISTRATION, WASHINGTON, DC.**
Rotorcraft master plan [AD-A239444] N91-32081
Satellite Communications (SATCOM) N91-32095
International Civil Aviation Organization (ICAO) Automatic Dependent Surveillance Panel (ADSP) activities N91-32097
International program summary N91-32098
Near-term satellite-based oceanic air traffic control: Ground system description N91-32116
US oceanic air traffic control: Past, present, and future N91-32118
Flight operations and air traffic management integration N91-32122
**FERMI NATIONAL ACCELERATOR LAB., BATAVIA, IL.**
An approximate HSPICE model for orbit low noise analog bipolar NPN transistors [DE91-017220] N91-32414
Future prospects for networking in the United States [DE91-017359] N91-32849
Design of the Digital Sky Survey DA and online system: A case history in the use of computer aided tools for data acquisition system design [DE91-016469] N91-33032
Testing the big bang: Light elements, neutrinos, dark matter, and large-scale structure [DE91-017379] N91-33040
**FLORIDA STATE UNIV., TALLAHASSEE.**
Potential vorticity index N91-32672
Remote sensing of water vapor features N91-32682
Observing system simulation experiments for the laser atmospheric wind sounder using global spectral model N91-32686
**FLORIDA UNIV., GAINESVILLE.**
E and DE/DT waveshapes for narrow bipolar pulses in intracloud lightning N91-32610
Characterization of vertical electric fields and associated voltages induced on a overhead power line from close artificially initiated lightning N91-32629
A system for mapping sources of VHF and electric field pulses from in-cloud lightning at KSC N91-32697
Voltages induced on a power distribution line by overhead cloud lightning N91-32734
Influence of channel base current and varying return stroke speed on the calculated fields of three important return stroke models N91-32736
**FOKKER SPACE AND SYSTEMS, AMSTERDAM (NETHERLANDS).**
Lightning protection of the Fokker 100 CFRP rudder N91-32612
**FRAUNHOFER-INST. FUER ATMOSPHAERISCHE UMWELTFORSCHUNG, GARMISCH-PARTENKIRCHEN (GERMANY, F.R.).**
Lidar measurements at Garmisch, conversion model, and midlatitude aerosol effects N91-32536
**FUJI HEAVY INDUSTRIES LTD., UTSUNOMIYA (JAPAN).**
Blended wing-body configuration design using transonic inverse code N91-32047
A numerical simulation of two dimensional shear layer N91-32060
**FUSION PHYSICS AND TECHNOLOGIES, TORRANCE, CA.**
Advanced fusion diagnostics [DE91-017412] N91-32941

## G

**GEC-PLESSEY SEMICONDUCTORS, LINCOLN (ENGLAND).**
An 8 bit high performance ADC in silicon on sapphire N91-32302
Technology approval using capability indices N91-32389
**GENERAL ATOMIC CO., SAN DIEGO, CA.**
Initial operational experience after installation of the D3-D radiation shield [DE91-017765] N91-32949
The evolution of US helium-cooled blankets [DE91-017938] N91-32952
**GENERAL SEMICONDUCTOR INDUSTRIES, INC., TEMPE, AZ.**
Hardening communication ports for survival in electrical overstress environments N91-32624
**GEORGE WASHINGTON UNIV., WASHINGTON, DC.**
A reference model dynamics-CMAC algorithm for simulation and control of robotic manipulators N91-32507
**GEORGETOWN UNIV., WASHINGTON, DC.**
Deployment and testing of a second prototype expandable surgical chamber in microgravity N91-32794
**GEORGIA INST. OF TECH., ATLANTA.**
Time domain finite elements in optimal control with application to launch vehicle guidance N91-32156
Failure mechanisms and prediction in advanced composite materials N91-32184
Additions to Mars Global Reference Atmospheric Model (Mars-GRAM) [NASA-CR-188924] N91-33045
**GINER, INC., WALTHAM, MA.**
Oxygen electrodes for rechargeable alkaline fuel cells, 3 N91-32561
**GOLKA (ROBERT K., JR.) ASSOCIATES, BROCKTON, MA.**
How to create ball lightning N91-32728
**GORDON (SANFORD), CLEVELAND, OH.**
The Navy/NASA Engine Program (NNEP89): Interfacing the program for the calculation of complex Chemical Equilibrium Compositions (CEC) [NASA-CR-187208] N91-32141
**GRUMMAN AEROSPACE CORP., BETHPAGE, NY.**
Effect of thermal exposure, forming, and welding on high-temperature, dispersion-strengthened aluminum alloy: Al-8Fe-1V-2Si [NASA-CR-187575] N91-32200

## H

**HAHN-MEITNER-INST. G.M.B.H., BERLIN (GERMANY, F.R.).**
Displacement threshold energy in GaAs determined by electrical and optical investigations N91-32337
Total dose effects in MOS systems: Influence of the initial hydrogen distribution N91-32338
Total dose study on LS-, ALS, and F-technology integrated circuits N91-32354
Irradiation tests and radiation hardness prediction considerations on electronic components for space application N91-32355
**HAMILTON STANDARD, WINDSOR LOCKS, CT.**
SPE (tm) water electrolyzers in support of mission from planet Earth N91-32552
**HARRIS CORP., PALM BAY, FL.**
Diffuse dispersive delay and the time convolution/attenuation of transients N91-32730
**HARRY DIAMOND LABS., ADELPHI, MD.**
Analog-to-digital conversion techniques [AD-A239469] N91-32796

**HAWAII UNIV., MANOA.**
Multi-dimensional modulation codes for fading channel [NASA-CR-188959] N91-32288
**HOKKAIDO UNIV. OF EDUCATION, IWAMIZAWA (JAPAN).**
On charging of snow particles in blizzard N91-32724
**HONEYWELL, INC., PHOENIX, AZ.**
ADS integration into the flight management computer N91-32114
**HOUSTON UNIV., CLEAR LAKE, TX.**
User documentation for the MSK and OMS intelligent tutoring systems [NASA-CR-188815] N91-32823

## I

**IAT, MENLO PARK, CA**
Automatic dependent surveillance benefit and cost analysis: Interim study results N91-32123
**IBIS TECHNOLOGY CORP., DANVERS, MA.**
The advantages of silicon-on-insulator technologies for space environments N91-32352
**IGG COMPONENT TECHNOLOGY LTD., PORTSMOUTH (ENGLAND).**
Upscreening of components for space applications N91-32376
The merits of an independent pre-cap inspection N91-32378
**ILLINOIS UNIV., URBANA-CHAMPAIGN.**
Computing and data processing N91-33028
Asymmetries in extragalactic radio sources N91-33050
**ILLINOIS UNIV. AT URBANA-CHAMPAIGN, SAVOY.**
Optimal cooperative time-fixed impulsive rendezvous N91-32153
**IMATRAN VOIMA OY, HELSINKI (FINLAND).**
Laser processing in power plants [DE91-527088] N91-32488
**IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND).**
Reciprocity theory of binary inelastic encounters [IC-AERO-89-03] N91-32425
**INDIAN INST. OF TROPICAL METEOROLOGY, POONA.**
A study of point discharge current observations in the thunderstorm environment at a tropical station during the year 1987 and 1988 N91-32721
**INFERENCE CORP., EL SEGUNDO, CA.**
Advanced Software Development Workstation Project, phase 3 [NASA-CR-188824] N91-32828
Advanced software development workstation project ACCESS user's guide [NASA-CR-188823] N91-32829
**INSTITUTE FOR COMPUTER APPLICATIONS IN SCIENCE AND ENGINEERING, HAMPTON, VA.**
An approximate Riemann solver for hypervelocity flows [NASA-CR-187629] N91-32463
**INSTITUTE FOR PERCEPTION RVO-TNO, SOESTERBERG (NETHERLANDS).**
Introduction to multiresolution morphology [IZF-1991-A-10] N91-32753
Advanced multiresolution morphology [IZF-1991-A-12] N91-32812
**INSTITUTE OF AVIATION MEDICINE, FARNBOROUGH (ENGLAND).**
Prevention and treatment of motion sickness: Non-pharmacological therapy N91-32767
Management of acute and chronic motion sickness N91-32769
**INSTITUTE OF COMPUTATIONAL FLUID DYNAMICS, TOKYO (JAPAN).**
Surface grid generation based on unstructured grid N91-32042
Several issues of visualization techniques in computational fluid dynamics 2 N91-32044
The three dimensional Navier-Stokes simulations of flow over a wing without any turbulent modelling N91-32051
**INSTITUTE OF OCEANOGRAPHIC SCIENCES, WORMLEY (ENGLAND).**
Chemical tracer studies at IOSDL-2: A method manual for the routine measurement of chlorofluocarbons in seawater and air [IOS-275] N91-32580
GEOPLOT: User guide and programmer's guide [IOS-279] N91-32745
**INTERNATIONAL BUSINESS MACHINES CORP., GAITHERSBURG, MD.**
Cooperative ADS/AAS integration N91-32120
**INTERNATIONAL BUSINESS MACHINES CORP., MANASSAS, VA.**
Single event test method and test results on the Intel 80386 N91-32343
**INTERNATIONAL CIVIL AVIATION ORGANIZATION, MONTREAL (QUEBEC).**
International standardization of future air navigation systems Automatic Dependent Surveillance (ADS) ICAO ADS Panel activities N91-32096
**INTERNATIONAL FUEL CELLS CORP., SOUTH WINDSOR, CT.**
Impact of fundamental technical improvements to natural gas fuel cells [PB91-206615] N91-32570
**INTERNATIONAL MARITIME SATELLITE ORGANIZATION, LONDON (ENGLAND).**
INMARSAT access approval N91-32110
**INTERSCIENCE, INC., TROY, NY.**
Heavy Neutral Beam Probe for edge plasma analysis in tokamaks [DE91-016290] N91-32935
**INTERUNIVERSITY MICRO-ELECTRONICS CENTER, LEUVEN (BELGIUM).**
New developments in non-volatile semiconductor memory technologies and devices N91-32295
Optimization of CMOS technology and design for deep cryogenic analog circuits N91-32296
**IOWA UNIV., IOWA CITY.**
High resolution measurements of density structures in the Jovian plasma sheet [NASA-CR-188918] N91-33043
**ISHIKAWAJIMA-HARIMA HEAVY INDUSTRIES CO. LTD., TOKYO (JAPAN).**
Supersonic inlet flow computations with cavity N91-32049
**ITT SEALECTRO (UK), PORTSMOUTYH (ENGLAND).**
Microwave blind mate coaxial connectors N91-32317

## J

**JAYCOR, VIENNA, VA.**
Gulf of Mexico circulation modeling study: Annual progress report: Years 3 and 4 [PB91-210666] N91-32746
**JET PROPULSION LAB., CALIFORNIA INST. OF TECH., PASADENA.**
Method and apparatus for producing microshells [NASA-CASE-NPO-16635-1-CU] N91-32240
The Telecommunications and Data Acquisition Report [NASA-CR-188813] N91-32250
Precise orbit determination of high-earth elliptical orbiters using differenced Doppler and range measurements N91-32251
Algorithms for structural natural-frequency design N91-32252
Pattern-recognition techniques applied to performance monitoring of the DSS 13 34-meter antenna control assembly N91-32253
A cooled 1- to 2-GHz balanced HEMT amplifier N91-32254
Performance of a high T(sub c) superconducting ultra-low loss microwave stripline filter N91-32255
Equivalent circuit model of traveling-wave maser slow-wave structures N91-32256
Spectral filters for laser communications N91-32257
Design and testing of an active quenching circuit for an avalanche photodiode photon detector N91-32258
Analysis of a multiple reception model for processing images from the solid-state imaging camera N91-32259
The Advanced Receiver II telemetry test results at Goldstone N91-32260
Symbol lock detection in the ARX 2 and Block 5 receivers N91-32261
Design and status of the RF-digitizer integrated circuit N91-32262
Channel assignments and array gain bounds for the Ka-band array feed compensation system N91-32263
Coding gains and error rates from the Big Viterbi Decoder N91-32264
Testing interconnected VLSI circuits in the Big Viterbi Decoder N91-32265
Frame error rate of the NASA concatenated coding system N91-32266
Initial pointing calibrations for the DSS 13 34-meter beam-waveguide antenna N91-32267
Modeling and simulations of the DSS 13 antenna control system N91-32268
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 1: Design and ground tests N91-32269
A portable Ka-band front-end test package for beam-waveguide antenna performance evaluation. Part 2: Tests on the antenna N91-32270
Efficiency calibration of the DSS 13 34-meter diameter beam waveguide antenna at 8.45 and 32 GHz N91-32271
DSS 13 phase 2 pedestal room microwave layout N91-32272
A carrier-arraying demonstration at Goldstone for receiving Pioneer 11 signals N91-32273
Delta VLBI data performance in the Galileo spacecraft Earth flyby of December 1990 N91-32274
Carrier-to-noise power estimation for the Block 5 Receiver N91-32275
JPL 1990-3: A 5-nrad extragalactic source catalog based on combined radio interferometric observations N91-32276
Wideband waveguide polarizer development for SETI N91-32277
Stochastic availability analysis of operational data systems in the Deep Space Network N91-32278
Modeling preparation costs for space missions by using major cost drivers N91-32279
Test chips and ASIC qualification N91-32327
The NASA Microelectronics Space Radiation Effects Program (MSREP) at the Jet Propulsion Laboratory N91-32331
Heavy-ion induced single-event upset in integrated circuits N91-32347
Evaluation of advanced microelectronics for inclusion in MIL-STD-975 N91-32390
Quantum well, beam deflecting surface emitting lasers [NASA-CASE-NPO-18243-1-CU] N91-32489
Telerobot control system [NASA-CASE-NPO-18116-1-CU] N91-32509
A generalized compliant motion primitive [NASA-CASE-NPO-18134-1-CU] N91-32510
Sodium-metal chloride battery research at JPL N91-32566
Advances in Li-TiS2 cell technology N91-32567
Highly parallel computer architecture for robotic computation [NASA-CASE-NPO-17632-1-CU] N91-32805
Analog hardware for learning neural networks [NASA-CASE-NPO-17664-1-CU] N91-32852
Method and apparatus for phasing segmented mirror arrays [NASA-CASE-NPO-18095-1-CU] N91-32923
Feedback controlled optics with wavefront compensation [NASA-CASE-NPO-18194-1-CU] N91-32924
Optoelectronic associative memory [NASA-CASE-NPO-18278-1-CU] N91-32925
Integrated filter and detector array for spectral imaging [NASA-CASE-NPO-18317-1-CU] N91-32926
**JOHNS HOPKINS UNIV., LAUREL, MD.**
Space qualification test and evaluation of JHU/APL designed ASICs N91-32315
**JOHNSON CONTROLS, INC., MILWAUKEE, WI.**
Multiple cell common pressure vessel nickel hydrogen battery N91-32564
**JOINT INST. FOR LAB. ASTROPHYSICS, BOULDER, CO.**
Atomic and molecular collision processes [DE91-017649] N91-32897

## K

**KAISERSLAUTERN UNIV. (GERMANY, F.R.).**
Wide band systems N91-32242
**KANSAS UNIV., LAWRENCE.**
Annular denuder systems: Precision and applicability to stratospheric sampling N91-32532
**KARLSRUHE UNIV. (GERMANY, F.R.).**
Some current approaches in turbulence modelling N91-32446
**KAWASAKI HEAVY INDUSTRIES LTD., GIFU (JAPAN).**
The role of computational fluid dynamics in aeronautical engineering (8): A mixed compression inlet for a supersonic airplane N91-32048
**KENT STATE UNIV., OH.**
Versatile, low-cost, computer-controlled, sample positioning system for vacuum applications [NASA-CR-187144] N91-32237
**KERNFORSCHUNGSZENTRUM G.M.B.H., KARLSRUHE (GERMANY, F.R.).**
In situ measurements of light extinction of stratospheric aerosols N91-32541
**KRUG INTERNATIONAL, HOUSTON, TX.**
Mini-rack testbed evaluation N91-32779
Transport suction apparatus and absorption materials evaluation N91-32784
Minor surgery in microgravity N91-32786
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) N91-32787
Evaluation of cardiopulmonary resuscitation techniques in microgravity N91-32789
Fluid handling 2: Surgical applications N91-32790
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility N91-32791

**KRUPP (FRIED.) G.M.B.H., ESSEN (GERMANY, F.R.).**
Krupp Technical Reports, number 2, December 1990 (English version)
[ISSN-0930-9276] N91-32994
The role of Krupp Forschungsinstitut in international R and D cooperation N91-32996
**KRUPP ATLAS-ELEKTRONIK, BREMEN (GERMANY, F.R.).**
Know-how for Europe N91-32997
**KRUPP CORPOPLAST MASCHINENBAU G.M.B.H., HAMBURG (GERMANY, F.R.).**
Manufacture of containers from an oriented biopolymer N91-32999
**KRUPP WIDIA G.M.B.H., ESSEN (GERMANY, F.R.).**
Europe 1993: Challenge and opportunity for distribution logistics N91-32998
**KYOTO UNIV. (JAPAN).**
Numerical analysis of bubbly liquid in convergent-divergent nozzle N91-32052
**KYUSHU UNIV., FUKUOKA (JAPAN).**
Numerical simulation of unsteady compressible viscous flows using an implicit upwind relaxation scheme N91-32041

## L

**LABEN FERRANTI INTERNATIONAL, VIMODRONE (ITALY).**
A solid state mass memory for space applications: Technological and system aspects N91-32329
**LABORATOIRE D'AEROLOGIE, TOULOUSE (FRANCE).**
The detection of the electric field vertical distribution underneath thundercloud: Principle and applications N91-32653
**LAWRENCE LIVERMORE NATIONAL LAB., CA.**
Scouting the neighborhood: In our lifetime
[DE91-017083] N91-32151
Autoignition chemistry of C4 olefins under motored engine conditions: A comparison of experimental and modeling results
[DE91-016511] N91-32197
Thermal-mechanical and physical-chemical properties of phosphate laser glasses
[DE91-016604] N91-32227
Pressure safety training
[DE91-015717] N91-32238
Initial testing of a two-dimensional computer code for microwave-induced surface breakdown in air
[DE91-015763] N91-32286
Development and operation of a solid-state switch for thyratron replacement
[DE91-016553] N91-32401
Design criteria for a magnetic switch when used to discharge a pulse forming line
[DE91-016559] N91-32402
Performance of a 10 kV, 625 kA, 85 kJ energy discharge module utilizing a solid dielectric switch
[DE91-017432] N91-32409
Reliable, high repetition rate thyratron grid driver used with a magnetic modulator
[DE91-016558] N91-32413
Wideband microwave generation with GaAs photoconductive switches
[DE91-017544] N91-32415
High temperature superconductivity: The early 1991 edition
[DE91-017655] N91-32417
Simulation of single mode Richtmyer-Meshkov instability using the adaptive free Lagrange method
[DE91-017657] N91-32457
A two-dimensional dynamic mix model in free Lagrange hydrodynamics
[DE91-017661] N91-32467
Some stable reconstruction algorithms for electrical impedance tomography
[DE91-016569] N91-32473
Laser performance and optical properties of LiSrGaF6:Cr(3+)
[DE91-016555] N91-32481
High average power magnetic modulator for copper lasers
[DE91-016560] N91-32482
Zonal deformable mirror for laser wavefront control
[DE91-017085] N91-32483
Coherent-state description of free-electron lasers
[DE91-017077] N91-32486
Future directions of laboratory x ray laser research
[DE91-017088] N91-32487
Application of telerobotic control to remote processing of nuclear material
[DE91-016562] N91-32501
Robot development for nuclear material processing
[DE91-016567] N91-32502
Inherently safe nuclear-driven internal combustion engines
[DE91-016568] N91-32503
Hot gas test results of a miniature free-piston pressurization pump driven by hydrazine decomposition products
[DE91-017072] N91-32504
An analog retina model for detecting moving objects against a moving background
[DE91-017428] N91-32544
Energy and technology review
[DE91-016873] N91-32572
Impact of reactive nitrogen emissions from fossil fuel combustion and biomass burning on atmospheric chemistry
[DE91-017651] N91-32588
Geoengineering the climate
[DE91-017654] N91-32589
A three-dimensional numerical simulations of mesoscale flow over KSC/CC area of Florida
[DE91-017445] N91-32743
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting
[DE91-017545] N91-32758
High-intensity photoionization of H2
[DE91-017087] N91-32885
Benchmark field study of deep neutron penetration
[DE91-015677] N91-32886
Basic features of coherent radiation generated by relativistic charge bunches
[DE91-017656] N91-32898
Infrastructure for thulium-170 isotope power systems for autonomous underwater vehicle fleets
[DE91-017464] N91-32911
Distortion free projection lithography
[DE91-016570] N91-32916
The surface morphology of as-deposited and laser-damaged dielectric mirror coatings studied in situ by atomic force microscopy
[DE91-016571] N91-32917
Wafer cost analysis for a soft x ray projection lithography system
[DE91-016605] N91-32918
Fabrication of advanced x ray optics with magnetron mini-source arrays
[DE91-017093] N91-32919
L to H mode transitions and associated phenomena in divertor tokamaks
[DE91-017074] N91-32940
Inertial Confinement Fusion, Volume 1, Number 2
[DE91-017920] N91-32951
Analogous behavior in the quantum hall effect, anyon superconductivity, and the standard model
[DE91-016609] N91-32970
Fermi surface measurements in YBa2Cu3O(7-x) and La(1.874)Sr(126)CuO4
[DE91-017094] N91-32973
Mechanisms of defect production and atomic mixing in high energy displacement cascades: A molecular dynamics study
[DE91-017082] N91-32979
Microstructural change and its influence on stress-strain behavior of two superplastic materials
[DE91-017431] N91-32980
Spectroscopic properties of Nd3+ dopant ions in phosphate laser glass
[DE91-017665] N91-32985
Nuclear and astronomical constraints on the site for r-process nucleosynthesis
[DE91-016561] N91-33038
Astrophysical neutron capture processes
[DE91-017071] N91-33039
Baryon inhomogeneity from the cosmic quark-hadron phase transition
[DE91-016608] N91-33051
Earth sciences report, 1989 - 1990
[DE91-017132] N91-33053
**LEHIGH UNIV., BETHLEHEM, PA.**
High octane ethers from synthesis gas-derived alcohols
[DE91-016596] N91-32193
**LEICESTER UNIV. (ENGLAND).**
Further proton damage effects in EEV CCDs N91-32340
**LIFE SYSTEMS, INC., CLEVELAND, OH.**
Space water electrolysis: Space Station through advance missions N91-32553
**LIGHTNING ELIMINATORS CO., INC., BOULDER, CO.**
Advances in lightning protection that satisfies contemporary standards N91-32731
**LIGHTNING LOCATION AND PROTECTION, INC., TUCSON, AZ.**
Range estimation techniques in single-station thunderstorm warning sensors based upon gated, wideband, magnetic direction finder technology N91-32618
**LIGHTNING TECHNOLOGIES, INC., PITTSFIELD, MA.**
Design of lightning protection for a full-authority digital engine control N91-32717
Certification of lightning protection for a full-authority digital engine control N91-32718
**LIMBURGS UNIV., DIEPENBEEK (BELGIUM).**
A new approach to the reliability of electronic material systems N91-32310
**LOS ALAMOS NATIONAL LAB., NM.**
The application of time-resolved luminescence spectroscopy to a remote uranyl sensor
[DE91-016310] N91-32189
The new metals and alloys compilation, a powerful materials analysis tool
[DE91-016199] N91-32208
De Haas van Alphen effect in high temperature superconductors
[DE91-016198] N91-32397
Rate effects of standard and high strip current Microchannel Plate Image Intensifiers (MCPIIs)
[DE91-016196] N91-32407
Determining finite volume elements for the 2D Navier-Stokes equations
[DE91-016028] N91-32452
Small signal gain for parabolic profile beams in free electron lasers
[DE91-016236] N91-32478
Applications of synchroscan and dual-sweep streak camera techniques to free-electron laser experiments
[DE91-016017] N91-32479
Laser-based diagnostics for density, temperature, velocity, and dissociation fraction in high temperature hydrogen flows
[DE91-016323] N91-32480
Interferometric results from Boeing grazing incidence ring resonator FEL
[DE91-016305] N91-32484
Spontaneous emission from free electron lasers
[DE91-017820] N91-32491
The Los Alamos photoinjector-driven free-electron laser
[DE91-017824] N91-32492
Simulation of APLE photoinjector
[DE91-018048] N91-32493
Modeling water content effects in polymer electrolyte fuel cells
[DE91-016027] N91-32573
Quality assurance of field screening
[DE91-016303] N91-32582
Mexico City air quality research initiative: An overview and some statistical aspects
[DE91-018045] N91-32590
Present and future supercomputer network architectures
[DE91-018035] N91-32855
What's happening with supercomputer networks?
[DE91-018036] N91-32856
Empirical results of a hybrid Monte Carlo method for the solution of Poisson's equation
[DE91-016240] N91-32863
Inconsistencies with the single impurity Undersign model in photoelectron spectra of cerium heavy fermion compounds
[DE91-016239] N91-32878
Measurements of induced radioactivity in some LDEF samples
[DE91-016309] N91-32882
International workshop on cold neutron sources
[DE91-017559] N91-32891
X ray absorption fine structure of systems in the anharmonic limit
[DE91-016070] N91-32892
Giant resonances in single and double charge exchange
[DE91-017822] N91-32900
Single- and double-charge exchange at low pion energies
[DE91-017829] N91-32901
A pulsed lepton source at LAMPF
[DE91-016010] N91-32904
Advanced high brightness ion RF accelerator applications in the nuclear energy
[DE91-016075] N91-32905
Review of the heavy ion physics sessions
[DE91-017828] N91-32912
Radiation-induced attenuation of high-OH optical fibers after hydrogen treatment in the presence of ionizing radiation
[DE91-016093] N91-32921
Further development of IDGS: Isotope dilution gamma-ray spectrometry
[DE91-016315] N91-32936
The promise of magnetized fuel: High gain in inertial confinement fusion
[DE91-016321] N91-32937

A new variational formulation of kinetic plasma theory and the application of moving finite elements
[DE91-016072] N91-32938
Radiation hardening of diagnostics
[DE91-018039] N91-32953
La(sup 139) NMR and NQR study of the temperature dependent structure of La2CuO4+(delta)
[DE91-016201] N91-32959
High pressure Moessbauer spectroscopy in diamond anvil cells
[DE91-016018] N91-32961
Solar particle events during the rising phase of solar cycle 22
[DE91-016042] N91-33049

**LOUGHBOROUGH UNIV. OF TECHNOLOGY (ENGLAND).**
A family of optimally conditioned quasi-Newton updates for unconstrained optimization
[MATHS-REPT-A-143] N91-32807
An r-matrix approach to nonstandard classes of integrable equations
[MATHS-REPT-A-149] N91-32861

**LOVELACE BIOMEDICAL AND ENVIRONMENTAL RESEARCH INST., ALBUQUERQUE, NM.**
Biophysical and biomathematical adventures in radiobiology
[DE91-017484] N91-32750
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials
[DE91-017516] N91-32770

## M

**MANCHESTER COLL. OF SCIENCE AND TECHNOLOGY (ENGLAND).**
HF systems operating beneath the ionosphere N91-32244
Comparison of lightning location data and polarisation radar observations of clouds N91-32710

**MARCONI ELECTRONIC DEVICES LTD., LINCOLN (ENGLAND).**
Simulation of radiation induced circuit failure modes in SOS integrated circuits N91-32351
SOS material improvement for post total dose, radiation induced leakage reduction N91-32353

**MARTIN MARIETTA AEROSPACE, DENVER, CO.**
Cryogenic Orbital Nitrogen Experiment (CONE): Phase A/B design study
[NASA-CR-187230] N91-32166

**MARYLAND UNIV., COLLEGE PARK.**
Cognitive cybernetics and human communication: The regulatory effects of prior knowledge N91-32771
Benefits to the nation from astronomy and astrophysics N91-33030

**MASSACHUSETTS INST. OF TECH., CAMBRIDGE.**
Structural characterization of high temperature composites
[NASA-CR-187220] N91-32180
Development of a spray-forming process for steel
[DE91-015812] N91-32218
Observations of Enhanced Radar Backscatter (ERB) from Millstone Hill
[NASA-CR-188877] N91-32280
Learning-logic: Casting the cortex of the human brain in silicon
[MIT-TR-47] N91-32840
Optical/IR from ground N91-33020

**MASSACHUSETTS UNIV., AMHERST.**
Climate research system
[DE91-016903] N91-32742

**MATRA ESPACE, PARIS-VELIZY (FRANCE).**
Surface mount on ceramic: How to achieve a space quality level N91-32309

**MATRA HARRIS SEMICONDUCTEURS, NANTES (FRANCE).**
Calibration of ASIC library for radiation tolerant space applications methodology and experiment N91-32334
Radiation tolerant 1 micron CMOS technology N91-32335

**MAXWELL LABS., INC., SAN DIEGO, CA.**
A transportable 50 kA dual mode lightning simulator N91-32633

**MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., BREMEN (GERMANY, F.R.).**
Rationales for the selection of a parts procurement system (coordinated versus centralized) from a prime contractor point of view N91-32371

**MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., MUNICH (GERMANY, F.R.).**
Withstanding voltage degradation of EEE components due to cavity pressure loss N91-32313
Total dose characterization of new components for the ESA radiation effects database N91-32362
A statistical evaluation of EEE-parts procurement data from telecommunication satellites N91-32368

**METEOROLOGICAL OFFICE, BRACKNELL (ENGLAND).**
Experience gained in operation of the VLF ATD lightning location system N91-32707

**MICHIGAN STATE UNIV., EAST LANSING.**
Study of flow properties of wet solids using laser induced photo chemical anemometry
[DE91-016877] N91-32454

**MICHIGAN UNIV., ANN ARBOR.**
EXAM: A search for extragalactic antimatter N91-33035
Vertical mixing and methane photochemistry in the atmosphere of Uranus: Analysis of Voyager UVS occultation experiments
[NASA-CR-188789] N91-33042

**MIDWEST RESEARCH INST., GOLDEN, CO.**
SERI Solar Radiation Resource Assessment Project
[DE91-002164] N91-32575

**MINISTRY OF TRANSPORTATION, TOKYO (JAPAN).**
ADS (Automatic Dependent Surveillance) PET (Pacific Engineering Trial) program in Japan N91-32100
Satellite data link research and development program in Japan N91-32108

**MINNESOTA UNIV., MINNEAPOLIS.**
Stabilized finite element formulations for incompressible flow computations
[UMSI-91/66] N91-32431

**MITRE CORP., MCLEAN, VA.**
Impact of automation and data link enhancements on oceanic air traffic control N91-32117
Preliminary evaluation of ADS/radar correlation N91-32119
Ground automation processing of near-term oceanic ATC data link messages N91-32127

**MONROE ELECTRONICS, INC., LYNDONVILLE, NY.**
LT-23: The feedback vibrating capacitor fieldmeter N91-32722

**MONTANA STATE UNIV., BOZEMAN.**
Corrosion and arc erosion in MHD channels
[DE91-016829] N91-32939

## N

**NAGOYA INST. OF TECH. (JAPAN).**
Discussions on a long gap discharge to an EHV transmission tower by a rocket triggered lightning experiment N91-32654

**NAGOYA UNIV. (JAPAN).**
An incompressible flow solver N91-32040
Finite difference numerical prediction of aerodynamics for airfoil flying over wavy wall N91-32043

**NATIONAAL INST. VOOR KERNFYSICA EN HOGE ENERGIEFYSICA, AMSTERDAM (NETHERLANDS).**
Beam optics of the AmPS extraction line
[NIKHEF-K/AMPS/91-01] N91-32914

**NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL, WASHINGTON, DC.**
The decade of discovery in astronomy and astrophysics
[NASA-CR-188226] N91-33016
Working Papers: Astronomy and Astrophysics Panel Reports
[NASA-CR-188785] N91-33017

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, DC.**
NASA's challenge for tomorrow N91-32374

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CA.**
Prediction techniques for jet-induced effects in hover on STOVL aircraft
[NASA-TM-102818] N91-32070
Comparisons of elastic and rigid blade-element rotor models using parallel processing technology for piloted simulations
[NASA-TM-102859] N91-32071
Aeroelastic loads and stability investigation of a full-scale hingeless rotor
[NASA-TM-103867] N91-32134
Human-centered aircraft automation: A concept and guidelines
[NASA-TM-103885] N91-32135
Development and evaluation of an inverse solution technique for studying helicopter maneuverability and agility
[NASA-TM-102889] N91-32145
Parabolized Navier-Stokes methods for hypersonic flows N91-32433
International Workshop on Stratospheric Aerosols: Measurements, Properties, and Effects
[NASA-CP-3114] N91-32528
Science issues N91-32529
Measurements N91-32530
Planetary astronomy N91-33027
SOFIA: A Stratospheric Observatory for Infrared Astronomy
[NASA-TM-103840] N91-33033

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.**
Leaching behavior of microtektite glass compositions in sea water and the effect of precipitation on glass leaching
[NASA-TM-105106] N91-32225
An overview of the NASA electronic components information management system N91-32369
Generation of topographic terrain models utilizing synthetic aperture radar and surface level data
[NASA-CASE-GSC-13212-1] N91-32546

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. HUGH L. DRYDEN FLIGHT RESEARCH CENTER, EDWARDS, CA.**
From an automated flight-test management system to a flight-test engineer's workstation
[NASA-TM-104242] N91-32851

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. HUGH L. DRYDEN FLIGHT RESEARCH FACILITY, EDWARDS, CA.**
Preliminary flight evaluation of an engine performance optimization algorithm
[NASA-TM-4328] N91-32140
A NASA/RAE cooperation in the development of a real-time knowledge-based autopilot
[NASA-TM-104234] N91-32850

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. JOHN C. STENNIS SPACE CENTER, BAY SAINT LOUIS, MS.**
Gamma ray collimator
[NASA-CASE-SSC-00013-1] N91-32515

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. JOHN F. KENNEDY SPACE CENTER, COCOA BEACH, FL.**
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 1
[NASA-CP-3106-VOL-1] N91-32599
The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, volume 2
[NASA-CP-3106-VOL-2] N91-32693
Surface wind convergence as a short-term predictor of cloud-to-ground lightning at Kennedy Space Center: A four-year summary and evaluation N91-32703
Lightning mapping system N91-32713

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TX.**
Two fault tolerant toggle-hook release
[NASA-CASE-MSC-21671-1] N91-32498
Nozzle fabrication technique
[NASA-CASE-MSC-21299-2] N91-32508
Bidirectional drive and brake mechanism
[NASA-CASE-MSC-21540-1] N91-32514
Medical evaluations on the KC-135 1990 flight report summary
[NASA-TM-104740] N91-32776
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight N91-32780
Application and use of spinal immobilization devices in zero-gravity flight N91-32781
ATLS: Catheter and tube placement N91-32782
Evaluation of aerosolized medications during parabolic flight maneuvers N91-32783
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals N91-32785
Venipuncture and intravenous infusion access during zero-gravity flight N91-32788
Shuttle Orbiter medical system equipment/supplies evaluation N91-32793
Three dimensional moire pattern alignment
[NASA-CASE-MSC-21416-1] N91-32922
Method for anisotropic etching in the manufacture of semiconductor devices
[NASA-CASE-MSC-21631-1] N91-32947

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, HAMPTON, VA.**
Unstructured-grid methods development for unsteady aerodynamic and aeroelastic analyses
[NASA-TM-104143] N91-32084
An experimental investigation of a supersonic vortical flow
[NASA-TM-105102] N91-32085
Nozzle diffuser for use with an open test section of a wind tunnel
[NASA-CASE-LAR-14424-1-SB] N91-32149
Ignitability test method and apparatus
[NASA-CASE-LAR-14454-1] N91-32196
Linear mass actuator
[NASA-CASE-LAR-14352-1] N91-32511

Lanczos eigensolution method for high-performance computers
[NASA-TM-104108] N91-32526
Validation of lidar and satellite remote sensing N91-32535
Gigaflop performance on a CRAY-2: Multitasking a computational fluid dynamics application
[NASA-TM-4305] N91-32841
NASA/DoD aerospace knowledge diffusion research project: Phase 3 academic library respondents including frequency distributions
[NASA-TM-104095] N91-33013

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OH.**

An experimental study of natural and forced modes in an axisymmetric jet
[NASA-TM-105225] N91-32074
Unsteady flowfield of a propfan at takeoff conditions
[NASA-TM-105223] N91-32075
Application of an integrated flight/propulsion control design methodology to a STOVL aircraft
[NASA-TM-105254] N91-32143
Ion beam sputtering in electric propulsion facilities
[NASA-TM-105145] N91-32158
The NASA cryogenic fluid management technology program plan
[NASA-TM-105256] N91-32161
MPD thruster technology
[NASA-TM-105242] N91-32162
Fiber-optic applications for space-based engines
[NASA-TM-105235] N91-32163
Multimegawatt electric propulsion system design considerations
[NASA-TM-105152] N91-32164
Orr-Sherby-Dorn creep strengths of the refractory-metal alloys C-103, ASTAR-811C, W-5Re, and W-25Re
[NASA-TM-105228] N91-32165
Spectroscopic wear detector
[NASA-CASE-LEW-15200-1] N91-32167
Effect of lightning strike on bromine intercalated graphite fiber/epoxy composites
[NASA-TM-104507] N91-32177
Integrated mechanics for the passive damping of polymer-matrix composites and composite structures
[NASA-TM-104346] N91-32181
Progressive fracture in composites subjected to hygrothermal environment
[NASA-TM-105230] N91-32182
A new approximate sum rule for bulk alloy properties
[NASA-TM-105282] N91-32204
Theoretical modelling of AFM for bimetallic tip-substrate interactions
[NASA-TM-105280] N91-32215
Lubrication with sputtered MoS2 films: Principles, operation, limitations
[NASA-TM-105292] N91-32216
Ceramic coatings on smooth surfaces
[NASA-CASE-LEW-15164-2] N91-32229
Addition polyimides with enhanced processability
[NASA-CASE-LEW-15043-1] N91-32230
Data compression for full motion video transmission
[NASA-TM-105239] N91-32247
Millimeter wavelength communications applications for the SEI
[NASA-TM-105275] N91-32287
Neutron, gamma ray and post-irradiation thermal annealing effects on power semiconductor switches
[NASA-TM-105248] N91-32410
Comparison of high temperature, high frequency core loss and dynamic B-H loops of two 50 Ni-Fe crystalline alloys and an iron-based amorphous alloy
[NASA-TM-105205] N91-32412
A laser velocimeter investigation of the normal shock-wave boundary layer interaction
[NASA-TM-105201] N91-32440
Resonant triad in boundary-layer stability. Part 1: Fully nonlinear interaction
[NASA-TM-105208] N91-32458
Resonant triad in boundary-layer stability. Part 2: Composite solution and comparison with observations
[NASA-TM-105209] N91-32459
A k-epsilon modeling of near wall turbulence
[NASA-TM-105238] N91-32460
Computational simulation of high temperature metal matrix composite behavior
[NASA-TM-104378] N91-32520
Space Electrochemical Research and Technology
[NASA-CP-3125] N91-32549
The Au cathode in the system Li2CO3-CO2-CO at 800 to 900 C N91-32551
Raman spectral observation of a new phase observed in nickel electrodes cycled to failure N91-32556
Impedances of nickel electrodes cycled in various KOH concentrations N91-32557
Some recent studies with the solid-ionomer electrochemical capacitor N91-32562
Performance of a dual anode nickel-hydrogen cell N91-32563
Status of NASA's Stirling Space Power Converter Program
[NASA-TM-104512] N91-32569
Cray performance data from five benchmarks
[NASA-TM-105200] N91-32806
Reliability and cost: A sensitivity analysis
[NASA-TM-105293] N91-33014
Solar radiation on Mars: Update 1991
[NASA-TM-105216] N91-33046

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, AL.**

Materials and processes laboratory composite materials characterization task, part 1. Damage tolerance
[NASA-TM-103553] N91-32185
Electrodeposited zinc-nickel as an alternative to cadmium plating for aerospace application
[NASA-TM-103551] N91-32217
Lightning protection for shuttle propulsion elements N91-32630
NASA/MSFC FY91 Global Scale Atmospheric Processes Research Program Review
[NASA-CP-3126] N91-32660
Global water cycle N91-32661
Basic studies of baroclinic flows N91-32662
Climate dynamics experiments using a GCM simulations N91-32663
MAMS: High resolution atmospheric moisture/surface properties N91-32664
AMPR/SSMI data comparisons N91-32665
Atmospheric aerosol and Doppler lidar studies N91-32666
Global lightning studies N91-32667
WetNet operations N91-32668
Interactive access and management for four-dimensional environmental data sets using McIDAS N91-32670
Research highlights: June 1990 - May 1991 N91-32676
Airborne CW lidar measurements of atmospheric backscatter at 9.1 and 10.6 microns N91-32677
Computer modeling of pulsed CO2 lasers for lidar applications N91-32680
Beta measurements N91-32681
Global temperature variations N91-32683
WetNet: Using SSM/I data interactively for global distribution of rainfall and precipitable water N91-32685
The role of the sea-surface temperature distribution on numerically simulated cyclogenesis during ERICA N91-32688
South Pacific convergence zone and global scale circulations (Jul. 1987 - Jul. 1991). Observational and modeling studies of heat, moisture, precipitation, and global-scale circulation patterns (Jul. 1990 - Jul. 1993) N91-32691
Lightning to the upper atmosphere: A vertical light pulse from the top of a thunderstorm as seen by a payload bay TV camera of the space shuttle N91-32720
Rotationally actuated prosthetic helping hand
[NASA-CASE-MFS-28426-1] N91-32795

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. PASADENA OFFICE, CA.**

Method and apparatus for producing microshells
[NASA-CASE-NPO-16635-1-CU] N91-32240
Quantum well, beam deflecting surface emitting lasers
[NASA-CASE-NPO-18243-1-CU] N91-32489
Telerobot control system
[NASA-CASE-NPO-18116-1-CU] N91-32509
A generalized compliant motion primitive
[NASA-CASE-NPO-18134-1-CU] N91-32510
Highly parallel computer architecture for robotic computation
[NASA-CASE-NPO-17632-1-CU] N91-32805
Analog hardware for learning neural networks
[NASA-CASE-NPO-17664-1-CU] N91-32852
Method and apparatus for phasing segmented mirror arrays
[NASA-CASE-NPO-18095-1-CU] N91-32923
Feedback controlled optics with wavefront compensation
[NASA-CASE-NPO-18194-1-CU] N91-32924
Optoelectronic associative memory
[NASA-CASE-NPO-18278-1-CU] N91-32925
Integrated filter and detector array for spectral imaging
[NASA-CASE-NPO-18317-1-CU] N91-32926

**NATIONAL AEROSPACE LAB., AMSTERDAM (NETHERLANDS).**

Turbulence modelling: Survey of activities in Belgium and The Netherlands, an appraisal of the status and a view on the prospects N91-32444

**NATIONAL AEROSPACE LAB., KAKUDA (JAPAN).**

Numerical treatment of laminar flow in curved rectangular channels with entrance region N91-32053
Developing laminar flow and heat transfer in orthogonally rotating square ducts N91-32054
Flow and heat transfer in a curved annular pipe N91-32055
Turbulence model calculations on the effects of body forces on turbulent flows in a pipe N91-32056
Fully developed mixed convection in a horizontal pipe N91-32057

**NATIONAL AEROSPACE LAB., TOKYO (JAPAN).**

Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics
[NAL-SP-14] N91-32032
Numerical simulation of hypersonic flow around H-2 orbiting plane N91-32034
Numerical calculation of flow for scramjet engine N91-32035
Rarefied gas numerical wind tunnel 6: Delta wing N91-32039
Aerodynamic design of non-planar wing by inverse method with Navier-Stokes equation N91-32045
Navier-Stokes simulation for complete aircraft configuration N91-32046
Numerical simulation analysis of sidewall effects in two-dimensional wind tunnels N91-32050
Numerical simulation of shock wave emanating from a square shock tube N91-32061
Numerical simulation of thermal convection in a rectangular duct flow N91-32062
Unsteady flow analysis in two-dimensional compressor cascade N91-32064
Analysis of the aerodynamic performance of counter-rotating propeller by means of vortex lattice method N91-32065
Navier-Stokes analysis for flowfield around hovering rotor N91-32066
Numerical analysis of three-dimensional cascade flow N91-32067
Navier-Stokes computations of three-dimensional turbine cascade flows N91-32068
Application of 3-D Navier-Stokes computation to turbine vane design N91-32069

**NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, BOULDER, CO.**

Uncertainty analysis of a radome flush orifice air motion system for the measurement of aircraft incident angles
[PB91-198176] N91-32133
Research on diabatic initialization N91-32671

**NATIONAL GEOPHYSICAL DATA CENTER, BOULDER, CO.**

Study on observational systems: A review of meteorological and oceanographic education in observational techniques and the relationship to national facilities and needs
[PB91-198168] N91-32739
UJNR Tsunami Workshop Proceedings
[PB91-193656] N91-32747
Solar-geophysical data number 560, April 1991. Part 1: (Prompt reports). Data for March, February 1991, and late data
[PB91-193508] N91-33047
Solar-geophysical data number 560, April 1991. Part 2: (Comprehensive reports). Data for October 1990 and miscellaneous
[PB91-193516] N91-33048

**NATIONAL INST. FOR FUSION SCIENCE, NAGOYA (JAPAN).**

A global simulation of the magnetosphere with a long tail: Southward and northward IMF
[NIFS-99] N91-32592
Calibration source for electron cyclotron emission measurements
[NIFS-19] N91-32913
Macroscale implicit, electromagnetic particle simulation of inhomogeneous and magnetized plasmas in multi-dimensions
[NIFS-91] N91-32929
H-mode physics: Experimental observations and model theories. Lecture notes
[NIFS-92] N91-32930
Geometric dependence of the scaling law on the energy confinement time in H-mode discharges
[NIFS-93] N91-32931
ELMy-H mode as limit cycle and chaotic oscillations in tokamak plasmas
[NIFS-96] N91-32932
An H-mode-like bifurcation in core plasma of stellarators
[NIFS-97] N91-32933
Axial pressure profile effects on flute interchange stability in the tandem mirror GAMMA 10
[NIFS-98] N91-32934
Heat deposition on the partial limiter
[NIFS-28] N91-32954

Beam-driven currents in the 1/nu regime in a helical system
[NIFS-27] N91-32955
Edge electric field profiles of H-mode plasmas in JFT-2M tokamak
[NIFS-26] N91-32956
Development of the stellarator/heliotron research
[NIFS-84] N91-32957

**NATIONAL INST. FOR OCCUPATIONAL SAFETY AND HEALTH, CINCINNATI, OH.**
Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography
[PB91-173351] N91-32755

**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER, CO.**
NOAA backscatter studies N91-32679
Weak positive cloud-to-ground flashes in Northeastern Colorado N91-32712

**NATIONAL OPTICAL ASTRONOMY LAB. TUCSON, AZ.**
Infrared astronomy N91-33019
Interferometry N91-33022

**NATIONAL PHYSICAL LAB., TEDDINGTON (ENGLAND).**
Comparison of factors given in ICRU report 23 and IAEA TRS 277 for converting from exposure/air kerma to absorbed dose to water for medium energy x rays
[NPL-RSA(EXT)-15] N91-32147
Standards for polymer matrix composites. Part 2: Assessment and comparison of CRAG test methods
[NPL-DMM(A)-7-PT-2] N91-32174
A literature review of inclusion removal by filtration and flotation
[NPL-DMM(A)-13] N91-32201
Effect of prior mechanical deformation on hydrogen transport through 13 percent chromium martensitic stainless steel
[NPL-DMM(A)-14] N91-32202
Report on the photogrammetric determination of the shape of a 10m diameter microwave antenna
[NPL-MOM-103] N91-32248
The United Kingdom waveguide power standards above 40 GHz
[NPL-DES-105] N91-32395
A VDM-SL specification for the VI pattern matcher
[NPL-DITC-171/91] N91-32808
Approved Ada uniformity issues
[NPL-DITC-172/91] N91-32809
The language compatible arithmetic standard and Ada
[NPL-DITC-173/91] N91-32810
Acoustic damping of honeycomb-construction plates by pressure-sensitive adhesives
[NPL-DES-107] N91-32872
Noise levels of USAF aircraft in exercise Luce Belle
[NPL-RSA(EXT)-16] N91-32873
Intercomparison of standards of absorbed dose between the USSR and the UK
[NPL-RSA(EXT)-17] N91-32874
Environmental radioactivity measurement intercomparison exercise 1990
[NPL-RSA(EXT)-20] N91-32875

**NATIONAL RADIO ASTRONOMY OBSERVATORY, CHARLOTTESVILLE, VA.**
Radio astronomy N91-33018

**NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO).**
Three-dimensional time domain model of lightning including corona effects N91-32702

**NATIONAL SEVERE STORMS FORECAST CENTER, KANSAS CITY, MO.**
Severe thunderstorm cases of July 1989 thru June 1990
[PB91-201392] N91-32738

**NATIONAL SEVERE STORMS LAB., NORMAN, OK.**
Lightning threat to aircraft: Do we know all we need to know? N91-32600
Intracloud development of lightning strikes to aircraft N91-32602

**NATIONAL SPACE DEVELOPMENT AGENCY, TOKYO (JAPAN).**
A plan of NASDA's parts database in the reliability information system N91-32381

**NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION, BOULDER, CO.**
Wideband HF noise/interference modeling, part 1. First-order statistics. Technical memorandum series
[PB91-208454] N91-32281

**NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, DC.**
Aircraft accident report: Avianca, the Airline of Columbia, Boeing 707-321B, HK 2016, fuel exhaustion, Cove Neck, New York, January 25, 1990
[PB91-910404] N91-32087

**NATIONAL WEATHER SERVICE, SALT LAKE CITY, UT.**
CLINEWS: NOAA Western Region computer programs and problems
[PB91-200709] N91-32831

**NAVAL AEROSPACE MEDICAL INST., PENSACOLA, FL.**
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory N91-32761
Factors influencing susceptibility: Individual differences and human factors N91-32763

**NAVAL AIR TEST CENTER, PATUXENT RIVER, MD.**
Results of the recent precipitation static flight test program on the Navy P-3B antisubmarine aircraft N91-32626
Activation of the Navy's indirect effects lightning simulation laboratory N91-32628

**NAVAL ARCTIC RESEARCH LAB., BARROW (ALASKA).**
Naval arctic manual, ATP 17(A)
[PB91-193920] N91-32584

**NAVAL WEAPONS CENTER, CHINA LAKE, CA.**
Equations of learning and capacity of layered neural networks
[AD-A229633] N91-32857

**NEKTONICS, INC., CAMBRIDGE, MA.**
Spectral element methods for the unsteady Navier-Stokes equations N91-32432

**NEVADA UNIV., RENO.**
Nature and origin of secondary mineral coatings on volcanic rocks of the Black Mountain, Stonewall Mountain, and Kane Springs Wash volcanic centers, southern, Nevada
[NASA-CR-183493] N91-32591

**NEW MEXICO INST. OF MINING AND TECHNOLOGY, SOCORRO.**
Electrical emissions of airplanes flying in electrified clouds and their effect on airplane measurements of cloud electric fields N91-32609
Charge control experiments on a CH-53E helicopter in a dusty environment N91-32625
Electrification in winter storms and the analysis of thunderstorm overflight N91-32678
Observations of lightning processes using VHF radio interferometry N91-32695

**NIPPON ELECTRIC CO. LTD., TOKYO (JAPAN).**
Conservation of angular momentum in direct simulation Monte Carlo method N91-32038

**NIS UNIV. (YUGOSLAVIA).**
Mathematical models for determining the protected spaces of the vertical lightning rod N91-32634
A new approach to the determination of the striking distance from the lightning channel photos N91-32698

**NISSAN MOTOR CO. LTD., TOKYO (JAPAN).**
Numerical simulations of chemically reacting flow N91-32036

**NORTH CAROLINA STATE UNIV., RALEIGH.**
An approximate viscous shock layer technique for calculating chemically reacting hypersonic flows about blunt-nosed bodies
[NASA-CR-187617] N91-32441

**NORTH CAROLINA UNIV., CHAPEL HILL.**
Precipitation regime changes associated with climatic changes
[PB91-206656] N91-32740

**NORTH CAROLINA UNIV., CHARLOTTE.**
A magneto-sensitive skin for robots in space
[NASA-CR-188956] N91-32512

**NORWEGIAN DEFENCE RESEARCH ESTABLISHMENT, KJELLER.**
Development of procedures for verification of alleged use of chemical warfare agents: Application of procedures after a simulated attack on an air base
[FFI-91/6006] N91-32148
Analysis of samples for the second (1990) round robin interlaboratory exercise
[FFI-91/6004] N91-32188
Instability of shaped charged jets with general constitutive equations
[FFI-91/4004] N91-32203
The physics of the oscillating lightning N91-32696
A political scenario for Europe: Pan-European security system
[FFI-91/5009] N91-33015

**NOTRE DAME UNIV., IN.**
Compressible flows with vortical disturbances around a cascade of airfoils N91-32083

## O

**OAK RIDGE NATIONAL LAB., TN.**
Tensile and cyclic fatigue properties of SiC whisker-reinforced Al2O3
[DE91-015916] N91-32179
Fundamental metallurgical considerations in brazing and soldering
[DE91-016224] N91-32209
Electron energies in metals
[DE91-016759] N91-32214
Development of a spray-forming process for steel
[DE91-015812] N91-32218
Ordering energy of B2 alloys calculated in the frozen potential and Harris approximations
[DE91-017228] N91-32220
Heat transfer effectiveness of a thermal barrier coating with different fuel compositions
[DE91-015602] N91-32222
Advances in the design of toughened ceramics
[DE91-016767] N91-32228
Braun heat pump engine/compressor and its hermetic rod seal
[DE91-017151] N91-32239
Evidence for SF4 and SF2 formation in SF6 corona discharges
[DE91-015927] N91-32285
Neutron diffraction by the flux lattice in high-Tc superconductors
[DE91-017866] N91-32418
Neutron scattering from the flux lattice in high temperature superconductors
[DE91-017947] N91-32419
Parallelizing the spectral transform method, part 2
[DE91-017131] N91-32456
Historical sunshine and cloud data in the United States
[DE91-016825] N91-32741
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms
[DE91-017245] N91-32774
Parallel implementation of a nonsymmetric tridiagonal eigensolver
[DE91-016773] N91-32834
GOOSE: A Generalized Object-Oriented Simulation Environment
[DE91-016771] N91-32842
Automatic blocking of nested loops
[NASA-CR-188874] N91-32844
Spline methods for conservation equations
[DE91-017152] N91-32867
Gaussian elimination methods for calculating classical periodic trajectories in two dimensions
[DE91-017600] N91-32869
The case for lower probabilities as measures of uncertainty
[DE91-017870] N91-32870
A dynamical picture of hadron-hadron collisions with the string-parton model
[DE91-016278] N91-32881
Ultrarelativistic atomic collisions
[DE91-016768] N91-32884
International workshop on cold neutron sources
[DE91-017559] N91-32891
The extension of the HHIRF accelerators to produce radioactive ion beams
[DE91-017687] N91-32899
High energy spin waves in iron measured by neutron scattering
[DE91-017868] N91-32902
Computer simulation studies of high energy collision cascades
[DE91-016225] N91-32903
Tuning and matching of the BPX ICH system
[DE91-017872] N91-32950
Formation and annealing behavior of an amorphous layer induced by tin implantation into sapphire
[DE91-015929] N91-32960
Evidence for cation disorder in in-situ grown YBaCuO superconducting films
[DE91-016760] N91-32971
Advantages of enthalpy-temperature diagrams for nonazeotropic refrigerant mixtures
[DE91-016774] N91-32991

**OAK RIDGE Y-12 PLANT, TN.**
Gas tungsten arc adaptive welding
[DE91-017848] N91-32513

**OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES, PARIS (FRANCE).**
Solution of perfect gas viscous flows via compressible Navier-Stokes equations with wallslip conditions
[ONERA-RSF-13/3637-AY] N91-32435
Navier-Stokes flow calculations by an implicit non-centered method N91-32436
Numerical study of partitioned turbulence
[ONERA-RSF-20/3419-AY-124A] N91-32437
Spectral transfer analysis for subgrid-scale modelling N91-32438
Description and interpretation of aircraft lightning attachment electric and magnetic field measurements and video observation N91-32601
Current wave-form observed during lightning strikes on aircraft N91-32603
Modeling of electrically thick materials theoretical and experimental aspects N91-32605
VHF discharges in storm cells producing microbursts N91-32620

FD-TD calculation with composite materials. Application to C160 aircraft measurements N91-32637
FD-TD numerical simulation of an entire lightning strike on the C160 aircraft N91-32648
Observations of bi-directional leader development in a triggered lightning flash N91-32649
Application of surface electrical discharges to the study of lightning strikes on aircraft N91-32650
**OLD DOMINION UNIV., NORFOLK, VA.**
Investigation of radiative interactions in supersonic internal flows
[NASA-CR-188820] N91-32078
Infrared radiative energy transfer in gaseous systems
[NASA-CR-188925] N91-32462
**OREGON STATE UNIV., NEWPORT.**
Materials compatibility issues for fabric composite radiators
[DE91-017556] N91-32186
**OREGON UNIV., EUGENE.**
Ionization of NO at high temperature
[NASA-CR-188798] N91-32187
Monitoring interfacial dynamics by pulsed laser techniques
[DE91-016950] N91-32485
**OSAKA UNIV. (JAPAN).**
The electric field changes and UHF radiations caused by the triggered lightning in Japan N91-32652

## P

**PACIFIC NORTHWEST LAB., RICHLAND, WA.**
Performance enhancement using power beaming for electric propulsion Earth orbital transporters
[DE91-017287] N91-32168
A power beaming based infrastructure for space power
[DE91-017533] N91-32169
Irradiation-induced chromium depletion and its influence on integranular stress corrosion cracking of stainless steels
[DE91-017418] N91-32212
Benefit/cost comparison for utility SMES applications
[DE91-017425] N91-32408
Site-specific investigations on aquifer thermal energy storage for space and process cooling
[DE91-017534] N91-32576
Wind energy potential in the United States considering environmental and land-use exclusions
[DE91-017535] N91-32577
Interaction of extremely-low-frequency electromagnetic fields with humans
[DE91-015779] N91-32756
**PATRAS UNIV. (GREECE).**
Turbulence models for natural convection flows along a vertical heated plane N91-32447
**PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.**
Supersonic mixing enhancement by vorticity for high-speed propulsion
[NASA-CR-188920] N91-32079
An experimental study of fluctuating pressure loads beneath swept shock/boundary-layer interactions
[NASA-CR-188919] N91-32080
Projects within the Center for Advanced Materials
[PB91-205716] N91-32178
Nonlinear feedbacks between stratocumulus and synoptic-scale systems N91-32674
**PHILIPS COMPONENTS, CAEN (FRANCE).**
Reliability of microwave bipolar silicon transistors N91-32305
Bipolar microwave transistor technology N91-32324
**PHYSICS AND ELECTRONICS LAB. TNO, THE HAGUE (NETHERLANDS).**
CARPET: A versatile program for radar performance analysis
[FEL-91-B002] N91-32246
Design and evaluation of a GaAs MMIC X-band active RC quadrature power divider
[FEL-91-A076] N91-32396
Refinement of a pulsed CO2-laser rangefinder with heterodyne detection
[FEL-90-A303] N91-32477
WASP, the Weapon Analysis and Simulation Program
[FEL-90-A322] N91-32813
Maximum likelihood estimation applied to target motion analysis using second order derivatives
[FEL-89-A193] N91-32862
**PLESSEY RESEARCH (CASWELL) LTD., TOWCESTER (ENGLAND).**
An evaluation programme for the capability approval of GaAs MMICs N91-32303
High performance packages for space applications N91-32311
High performance packages for space applications: Review of packaging and assembly methods for long wavelength laser diodes N91-32318
Effects of design on total dose characteristics of ASIC technologies N91-32333
Component field failure data base N91-32380
**PURDUE UNIV., WEST LAFAYETTE, IN.**
Unstructured-grid methods development for unsteady aerodynamic and aeroelastic analyses
[NASA-TM-104143] N91-32084
Measurement of interfacial area using four sensor probe in two phase flow
[DE91-017415] N91-32466
Synoptic/planetary-scale interactions and blocking over the North Atlantic Ocean N91-32692

## R

**RAYCHEM LTD., SWINDON (ENGLAND).**
The performance of cable braids and terminations to lightning induced transients N91-32611
Lightning protection of full authority digital electronic systems N91-32643
**RAYTHEON CO., PATRICK AFB, FL.**
Weak positive cloud-to-ground flashes in Northeastern Colorado N91-32712
**REMOTE SENSING SYSTEMS, INC., SANTA ROSA, CA.**
Deriving Earth science products from SSM/I N91-32684
**RENSSELAER POLYTECHNIC INST., TROY, NY.**
Matrix-dominated thermoviscoplasticity in fibrous metal-matrix composite materials N91-32173
Nonlinear dynamic analysis of flexible multibody systems
[NASA-CR-187597] N91-32519
**RESEARCH INST. FOR ADVANCED COMPUTER SCIENCE, MOFFETT FIELD, CA.**
Smart instruments and the national collaboratory
[NASA-CR-188902] N91-32472
Contour-map encoding of shape for early vision
[NASA-CR-188937] N91-32545
Recognition of simple visual images using a sparse distributed memory: Some implementations and experiments
[NASA-CR-186616] N91-32797
The Cortex Transform as an image preprocessor for sparse distributed memory: An initial study
[NASA-CR-187436] N91-32798
Development of a sensor coordinated kinematic model for neural network controller training
[NASA-CR-188864] N91-32799
Workshop on NASA workstation technology
[NASA-CR-188866] N91-32800
An assessment of the connection machine
[NASA-CR-188876] N91-32801
Efficient packing of patterns in sparse distributed memory by selective weighting of input bits
[NASA-CR-188890] N91-32802
Automated IDEF3 and IDEF4 systems design specification document
[NASA-CR-188830] N91-32803
IDEF3 and IDEF4 automation system requirements document and system environment models
[NASA-CR-188829] N91-32804
On polynomial preconditioning for indefinite Hermitian matrices
[NASA-CR-188857] N91-32814
Is thinking computable?
[NASA-CR-188859] N91-32815
Evolutionary tree reconstruction
[NASA-CR-188862] N91-32816
Saving all the bits
[NASA-CR-188879] N91-32817
QMR: A Quasi-Minimal Residual method for non-Hermitian linear systems
[NASA-CR-188882] N91-32818
Beyond formalism
[NASA-CR-188886] N91-32819
An implementation of the look-ahead Lanczos algorithm for non-Hermitian matrices
[NASA-CR-188889] N91-32820
Krylov subspace methods for complex non-Hermitian linear systems
[NASA-CR-188891] N91-32821
Mutual exclusion
[NASA-CR-188122] N91-32822
Feasibility study on the use of groupware support for NASA source evaluation boards
[NASA-CR-188832] N91-32824
Programming in a proposed 9X distributed Ada
[NASA-CR-188831] N91-32825
Machine learning research 1989-90
[NASA-CR-188828] N91-32826
An intelligent tutoring system for the investigation of high performance skill acquisition
[NASA-CR-188827] N91-32827
Advanced Software Development Workstation Project, phase 3
[NASA-CR-188824] N91-32828
Advanced software development workstation project ACCESS user's guide
[NASA-CR-188823] N91-32829
Research into the interaction between high performance and cognitive skills in an intelligent tutoring system
[NASA-CR-188821] N91-32830
G/SPLINES: A hybrid of Friedman's Multivariate Adaptive Regression Splines (MARS) algorithm with Holland's genetic algorithm
[NASA-CR-188935] N91-32836
ART-Ada: An Ada-based expert system tool
[NASA-CR-188930] N91-32837
Ada issues in implementing ART-Ada
[NASA-CR-188941] N91-32838
Toward the efficient implementation of expert systems in Ada
[NASA-CR-188942] N91-32839
Automatic blocking of nested loops
[NASA-CR-188874] N91-32844
Multilevel filtering elliptic preconditioners
[NASA-CR-188851] N91-32845
Collaboration technology and space science
[NASA-CR-188861] N91-32846
Highly parallel sparse Cholesky factorization
[NASA-CR-188875] N91-32847
A biconjugate gradient type algorithm on massively parallel architectures
[NASA-CR-188888] N91-32848
Distributed memory approaches for robotic neural controllers
[NASA-CR-188865] N91-32859
Mapping unstructured grid problems to the connection machine
[NASA-CR-187719] N91-32864
SPARSKIT: A basic tool kit for sparse matrix computations
[NASA-CR-185876] N91-32865
Coping with data from Space Station Freedom
[NASA-CR-188885] N91-33005
**ROCHESTER UNIV., NY.**
Dynamics of surface melting
[DE91-016344] N91-32206
Picosecond time-resolved electron diffraction studies of laser heated metals
[DE91-016345] N91-32207
**ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA.**
Regenerative fuel cell architectures for lunar surface power N91-32560
**ROCKWELL INTERNATIONAL CORP., CEDAR RAPIDS, IA.**
ADS communications: A cornerstone N91-32105
**ROCKWELL INTERNATIONAL CORP., DOWNEY, CA.**
Lightning current rate of rise in the new lightning flash model for the space shuttle program N91-32604
**ROCKWELL INTERNATIONAL CORP., HOUSTON, TX.**
Design, development, and qualification of special super N-channel MOSFET die for space applications N91-32297
**ROYAL AEROSPACE ESTABLISHMENT, FARNBOROUGH (ENGLAND).**
Cost effective electronic components for short life space missions N91-32387
**RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ.**
Modeling of a large class of undamped flexible structures experiencing large angular excursions N91-32525
**RUTHERFORD APPLETON LAB., CHILTON (ENGLAND).**
The effect of a neutrino magnetic moment on nuclear excitation processes
[RAL-91-010] N91-32876
A unified formalism for gamma gamma to meson and psi to gammaX with possible tests for hybrid and gluonic hadrons
[RAL-91-039] N91-32877

## S

**SAAB SPACE A.B., GOETEBORG (SWEDEN).**
Radiation assessment of complex technologies N91-32342
**SAN DIEGO STATE UNIV., CA.**
Modeling the response of plants and ecosystems to global change
[DE91-017403] N91-32587
**SANDIA NATIONAL LABS., ALBUQUERQUE, NM.**
Interim explosives detection alternatives
[DE91-016188] N91-32089
Power system requirements and selection for the space exploration initiative
[DE91-016707] N91-32150
RV strings of maximum curvature
[DE91-016708] N91-32157

Effect of initial conditions on combustion generated loads
[DE91-016646] N91-32194
Constitutive modeling of salt behavior: State of the technology
[DE91-017459] N91-32199
The role of anodic dissolution in the stress corrosion cracking of Al-Li-Cu alloy 2090
[DE91-016403] N91-32219
Shock-vaporization studies on zinc and porous carbon
[DE91-017846] N91-32233
Mode-stirred chamber field statistics: Correlation widths
[DE91-016190] N91-32289
Laboratory test results of solid state video cameras
[DE91-016189] N91-32399
Stress states in wound capacitors
[DE91-016402] N91-32400
Low-cost 3 kV, triggered, stripline, surface-discharge switch
[DE91-016641] N91-32403
Processing issues and technologies for optoelectronics-integrated circuits and devices
[DE91-017451] N91-32406
Channel flow of a concentrated suspension
[DE91-016649] N91-32453
System requirements for low-Earth-orbit launch using laser propulsion
[DE91-017455] N91-32490
Development of a stretched-membrane dish
[DE91-016499] N91-32574
The Sandia transportable triggered lightning instrumentation facility N91-32636
Damage to metallic samples produced by measured lightning currents N91-32640
User's manual for PANDA 2: A computer code for calculating equations of state
[DE91-017717] N91-32843
Military robotics technologies at Sandia National Laboratories
[DE91-016113] N91-32858
Visible spectroscopy diagnostics of light-ion beams
[DE91-017450] N91-32908
Intense ion beam diagnostics for light ion inertial fusion experiments on PBFA 2
[DE91-017449] N91-32942
Graphite-metal brazing for thermal applications
[DE91-016647] N91-32944
La(sup 139) NMR and NQR study of the temperature dependent structure of La2CuO4+(delta)
[DE91-016201] N91-32959
Irradiation effects in high temperature superconductors
[DE91-016118] N91-32962
An overview of the electronic properties of InAs(1-x)Sb(x) strained-layer superlattices (O less than or equal to x less than or equal to 1)
[DE91-017458] N91-32976
Ion implantation effects in crystalline quartz
[DE91-016192] N91-32977
Teaching engineers to be technical leaders
[DE91-016117] N91-33002

**SCHOOL OF AEROSPACE MEDICINE, BROOKS AFB, TX.**
Publications and presentations of the Opthalmology Branch, USAF School of Aerospace Medicine, 1981-1990
[AD-A239458] N91-32754

**SELENIA SPAZIO S.P.A., ROME (ITALY).**
The role of photosensitive polyimides in the development of hybrid space hardware N91-32321
Results and considerations on failure investigations of components used for space equipment N91-32365

**SEXTANT AVIONIQUE, VALENCE (FRANCE).**
Characterization of 256 Kbits SRAMs under californium 252 and protons irradiations N91-32359

**SHIP RESEARCH INST., TOKYO (JAPAN).**
Wall function method with conservation property N91-32058

**SHIP STRUCTURE COMMITTEE, WASHINGTON, DC.**
Uncertainties in stress analysis on marine structures
[PB91-193441] N91-32522

**SIEMENS A.G., MUNICH (GERMANY, F.R.).**
Progress in submicron technologies N91-32394

**SIRA INST. LTD., CHISLEHURST (ENGLAND).**
Space radiation effects on CCDs N91-32339

**SOCIETE D'APPLICATIONS GENERALES D'ELECTRICITE ET DE MECANIQUE, CERGY-PONTOISE (FRANCE).**
Non volatile solid state magnetic memory technologies N91-32294

**SOCIETE INTERNATIONAL DE TELECOMMUNICATIONS AERONAUTIQUES, LONDON (ENGLAND).**
Aeronautical mobile satellite services ESA-PRODAT/SITA AIRCOM service trials programme N91-32106
SITA satellite air communications implementation N91-32113

**SOLAR KINETICS, INC., DALLAS, TX.**
Development of a stretched-membrane dish
[DE91-016499] N91-32574

**SOURIAU, PARAY (FRANCE).**
Mating and unmating of multi-pin connectors under vacuum N91-32319

**SOUTHAMPTON UNIV. (ENGLAND).**
Appraisal of the suitability of turbulence models in flow calculations: A UK view on turbulence models for turbulent shear flow calculations N91-32450
Physical characteristics of stimuli provoking motion sickness N91-32762
Sea sickness N91-32766

**SOUTHERN CALIFORNIA RESEARCH CORP., SAN RAFAEL.**
Natural gas conversion process
[DE91-015759] N91-32235

**SOUTHERN METHODIST UNIV., DALLAS, TX.**
The use of software metrics to evaluate information systems N91-33003

**SOUTHWEST RESEARCH INST., SAN ANTONIO, TX.**
Probabilistic Structures Analysis Methods (PSAM) for select space propulsion system components
[NASA-CR-187196] N91-32524
SEPAC data analysis in support of the environmental interaction program
[NASA-CR-184201] N91-32579

**SPARTAN MICROWAVE LTD., COSHAM (ENGLAND).**
Assembly and packaging of microwave gallium arsenide devices for the space environment N91-32325

**SPUR ELECTRON LTD., HAVANT (ENGLAND).**
EEC component procurement: A look ahead N91-32372

**SRI INTERNATIONAL CORP., MENLO PARK, CA.**
Airborne observations of electric fields around growing and decaying cumulus clouds N91-32616
Scale-model charge-transfer technique for measuring enhancement factors N91-32651

**ST SYSTEMS CORP., LANHAM, MD.**
System improvements identified by the North Atlantic Systems Planning Group (NAT/SPG) as related to the capabilities of the Oceanic Display and Planning System (ODAPS) N91-32109

**STANFORD LINEAR ACCELERATOR CENTER, CA.**
Soft and hard Pomerons: Is there a distinction?
[DE91-016048] N91-32883
Computation applied to particle accelerator simulations
[DE91-017128] N91-32906
The comparison and selection of programming languages for high energy physics applications
[DE91-017130] N91-32910

**STANFORD TELECOMMUNICATIONS, INC., WASHINGTON, DC.**
Use of ISO protocols in the ADS environment N91-32115

**STANFORD UNIV., CA.**
High-temperature thermomechanical behavior of carbon-phenolic and carbon-carbon composites N91-32171
Delaminations in composite plates under transverse static or impact loads N91-32183
Collaborative testing of turbulence models N91-32451
Fluid dynamics of double diffusive systems
[DE91-017401] N91-32465
Fracture characterization for thermoinelasticity N91-32517

**STATE UNIV. OF NEW YORK, BUFFALO.**
Active damping using a control structure interaction approach N91-32290

**STRATEGIC AIR COMMAND, OFFUTT AFB, NE.**
ICBM abbreviations and acronyms (2nd edition)
[PB91-193375] N91-33011

**SUPERCONDUCTING SUPER COLLIDER LAB., DALLAS, TX.**
Hamiltonians and Lagrangians for one-dimensional autonomous systems and dissipative systems
[DE91-017595] N91-32868

**SVERDRUP TECHNOLOGY, INC., BROOK PARK, OH.**
A comparison of the analytical and experimental performance of the solid version of a cooled radial turbine
[NASA-CR-187195] N91-32077
The Navy/NASA Engine Program (NNEP89): Interfacing the program for the calculation of complex Chemical Equilibrium Compositions (CEC)
[NASA-CR-187208] N91-32141
The internal caustic structure of illuminated liquid droplets
[NASA-CR-187194] N91-32474

**SWEDISH STATE POWER BOARD, STOCKHOLM.**
Lightning location system supervising Swedish power transmission network N91-32617

**SWISS CENTER FOR ELECTRONICS AND MICROTECHNOLOGY, INC., NEUCHATEL.**
Development of semiconductor test structures for reliability evaluation N91-32292

**SYRACUSE UNIV., NY.**
Improvement in radar detection under scan-to-scan processing and scan rate reduction N91-32245
Research program in elementary particle theory (task A)
[DE91-016937] N91-32895

**SYSTEMS CONTROL TECHNOLOGY, INC., ARLINGTON, VA.**
Analysis of rotorwash effects in helicopter mishaps
[DOT/FAA/RD-90/17] N91-32086

## T

**TECHNISCHE UNIV., HANOVER (GERMANY, F.R.).**
Hanover University research report
[ISSN-0723-1903] N91-33052

**TECNOLOGICA S.A., LA LAGUNA (SPAIN).**
Space silicon diodes: A survey of available technologies and related manufacturing and reliability aspects N91-32320
Space flight components database N91-32377
CPFS: The total information system tool for EEE-parts procurement N91-32379

**TEXAS A&M UNIV., COLLEGE STATION.**
New directions for the catalytic conversion of methane
[PB91-206417] N91-32191
High energy efficiency and high power density proton exchange membrane fuel cells: Electrode kinetics and mass transport N91-32558
Tropical Pacific moisture variability N91-32690
Study of neutron-proton interaction in the 300 to 700 MeV energy region
[DE91-016487] N91-32887

**TEXAS INSTRUMENTS FRANCE, VELIZY-VILLACOUBLAY.**
An advanced testability concept for space applications N91-32323

**TEXAS INSTRUMENTS FRANCE, VILLENEUVE-LOUBET.**
Space manufacturing quality through statistical process control: An application at Texas Instruments France, a space semiconductors production line N91-32384

**TEXAS UNIV., AUSTIN.**
Hamiltonian chaos and transport in quasigeostrophic flows
[DE91-017385] N91-32464
Excitation of nonlinear wake field in a plasma for particle acceleration
[DE91-017386] N91-32945
Kinetic theory of RF current drive and helicity injection
[DE91-017388] N91-32946

**TEXAS UNIV. HEALTH SCIENCE CENTER, SAN ANTONIO.**
Health maintenance facility: Dental equipment requirements N91-32777
Dental equipment test during zero-gravity flight N91-32778

**THOMSON AND NIELSEN ELECTRONICS, OTTAWA (ONTARIO).**
Advances in SEM beam micro-irradiation N91-32360

**THOMSON-CSF, BAGNEUX (FRANCE).**
Total dose effects on Charge Coupled Devices (CCD) reverse annealing phenomena N91-32341

**THOMSON-CSF, ORSAY (FRANCE).**
EQML: A chance for Europe N91-32383
Which position for MIL-space industry facing QML concept N91-32386

**THOMSON-CSF, SAINTE EGREVE (FRANCE).**
Total quality management: What are the facts behind the concepts? N91-32385

**TOHOKU UNIV., SENDAI (JAPAN).**
Numerical turbulent simulations of unsteady transonic cascade flows N91-32063
Characteristics of winter lightning currents struck an isolated tower N91-32607

**TOKYO METROPOLITAN UNIV. (JAPAN).**
On the parallel processing of Direct Simulation Monte Carlo method N91-32037

**TOKYO NOKO UNIV. (JAPAN).**
Active control of vortex shedding frequency by a splitter plate N91-32059

**TOKYO UNIV. (JAPAN).**
Application of AI to engineering problems N91-32033

**TOYOTA COLL. OF TECHNOLOGY (JAPAN).**
The electric field change caused by a ground flash with multiple channels N91-32647
**TRANSPORT CANADA AVIATION, OTTAWA (ONTARIO).**
Automatic Dependent Surveillance (ADS) development in Canada N91-32104
**TRW COMPONENTS INTERNATIONAL, INC., TORRANCE, CA.**
Parts management for the 1990's N91-32375
**TURKISH AEROSPACE INDUSTRIES, ANKARA.**
Computational turbulence studies in Turkey N91-32449

## U

**UMWELTBUNDESAMT, BERLIN (GERMANY, F.R.).**
Proceedings of 2nd US/FRG Workshop on Photochemical Ozone Problem and its Control [PB91-211847] N91-32583
**UNISYS CORP., LANHAM, MD.**
A comparison of the specifications for standard Electrical, Electronic and Electromechanical (EEE) parts used by the National Aeronautics and Space Admininstration (NASA) and the European Space Agency (ESA): Towards common specifications N91-32391
**UNITED KINGDOM ATOMIC ENERGY AUTHORITY, ABINGDON (ENGLAND).**
Investigations into the damage for various types of unprotected carbon fibre composites with a variety of lightning arc attachments N91-32606
The electromagnetic environment in CFC structures N91-32638
A new approach to equipment testing N91-32639
Lightning protection design and testing of an all composite wet wing for the Egrett N91-32642
**UNITED KINGDOM ATOMIC ENERGY AUTHORITY, CULHAM (ENGLAND).**
Measurements of some parameters of thermal sparks with respect to their ability to ignite aviation fuel/air mixtures N91-32705
The new Section 23 of DO160C/ED14C lightning testing of externally mounted electrical equipment N91-32716
**UNITED STATES-JAPAN TASK FORCE ON SCIENTIFIC AND TECHNICAL INFORMATION.**
Japan-US Liaison Group on Joint Databases Development [PB91-214056] N91-33006
**UNIVERSIDAD NACIONAL DE CORDOBA (ARGENTINA).**
Charge transfer during individual collisions in ice growing by riming N91-32727
**UNIVERSITE CATHOLIQUE DE LOUVAIN (BELGIUM).**
Propagation limitations for transionospheric systems from 10 to 300 GHz N91-32243
**UNIVERSITE DES SCIENCES ET TECHNIQUES DE LILLE (FRANCE).**
Aerosol sensing from balloons using photopolarimetry N91-32538
**UNIVERSITE DES SCIENCES ET TECHNIQUES DU LANGUEDOC, MONTPELLIER (FRANCE).**
Space radiation effects on power MOSFET: Threshold-voltage shift with dose rate N91-32363
Laser heated calcium sulfate TLD plates: Application to radiation mapping N91-32364
**UNIVERSITY COLL., CORK (IRELAND).**
Assessment of DFT strategies N91-32301
Assessment of p-metallisations for high power GaAs laser diodes N91-32316
MTSL-005: Reliability evaluation of high pincount hermetic ceramic packages for space applications N91-32328
Temperature compensation of PMOS dosimeters N91-32336
**UPPSALA UNIV. (SWEDEN).**
The Euler and Navier-Stokes equations. Wellposedness, stability and composite grids N91-32427
First and subsequent return stroke properties of cloud-to-ground lightning N91-32614
Correlation between some current parameters and optical radiation generated by 280 mm long laboratory sparks N91-32655
Power and energy dissipation in subsequent return strokes as predicted by a new return stroke model N91-32657
Horizontal fields generated by return strokes N91-32658

## V

**VANDERBILT UNIV., NASHVILLE, TN.**
A dynamical picture of hadron-hadron collisions with the string-parton model [DE91-016278] N91-32881
**VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.**
Optimal control problems with switching points [NASA-CR-4393] N91-32155
Interlaminar deformations on the cylindrical surface of a hole in laminated composites: An experimental study N91-32172
Modeling and analysis of spacecraft battery charger systems N91-32411
The development of solution algorithms for compressible flows N91-32423
Uncertainties in stress analysis on marine structures [PB91-193441] N91-32522
**VOEIKOV MAIN GEOPHYSICAL OBSERVATORY, LENINGRAD (USSR).**
On error sources during airborne measurements of the ambient electric field N91-32719
**VON KARMAN INST. FOR FLUID DYNAMICS, RHODE-SAINT-GENESE (BELGIUM).**
Computational Fluid Dynamics [VKI-LS-1991-01] N91-32426
Upwind methods and multidimensional splittings for the Euler equations N91-32429
Fluctuation splitting schemes for the 2D Euler equations N91-32430
Parabolized Navier-Stokes methods for ducted flow systems N91-32434
**VRIJE UNIV., BRUSSELS (BELGIUM).**
A general analysis of two-dimensional convection schemes N91-32428

## W

**WASHINGTON UNIV., SEATTLE.**
Color transparency: Enchantment and effort [DE91-016951] N91-32890
High energy from space N91-33023
Coalescing binary systems of compact objects to (post) sup 5/2 Newtonian order: Late-time evolution and gravitational radiation emission N91-33037
**WEATHER WING ( 4TH), CAPE CANAVERAL AFS, FL. DETACHMENT 11.**
Assessment and forecasting of lightning potential and its effect on launch operations at Cape Canaveral Air Force Station and John F. Kennedy Space Center N91-32704
**WERNER UND PFLEIDERER G.M.B.H. (GERMANY, F.R.).**
Development of polymer alloys for electrical engineering applications N91-33000
**WESLEY HOSPITAL, BRISBANE (AUSTRALIA).**
The QT interval in lightning injury with implications for the cessation of metabolism hypothesis N91-32621
Further identification and treatment modalities in telephone mediated lightning strike N91-32622
**WESTINGHOUSE HANFORD CO., RICHLAND, WA.**
The essential linearity of thermal radiation net transport [DE91-016734] N91-32990
**WICHITA STATE UNIV., KS.**
Electromagnetic emissions from an electro-impulse deicing system in a composite wing equipped with lightning protection [DOT/FAA/CT-TN90/32] N91-32284
**WISCONSIN UNIV., MADISON.**
Fast neutron dosimetry [DE91-016907] N91-32894
**WORLD METEOROLOGICAL ORGANIZATION, GENEVA (SWITZERLAND).**
Report of the expert group on global baseline datasets [WCDP-11] N91-32598
Information of meteorological extremes for the design and operation of energy systems [WCAP-13] N91-32659
**WRIGHT LAB., EGLIN AFB, FL.**
Thin layer Navier-Stokes solutions for transonic multibody interference [AD-A234252] N91-32072
**WYOMING UNIV., LARAMIE.**
Review of Air Force compressor blade and vane rework and it's impact on performance and costs [AD-A229518] N91-32136
Measurements in polar stratospheric clouds over Antarctica in September 1989 N91-32534

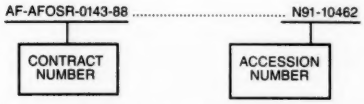
## Y

**YALE UNIV., NEW HAVEN, CT.**
Catalytic combustion of methane [PB91-206391] N91-32190
Nonlinear dynamics of global atmospheric and Earth-system processes N91-32687

## Z

**ZARAGOZA UNIV. (SPAIN).**
Turbulent flow modelling in Spain: Overview and developments N91-32448

### Typical Contract Number Index Listing



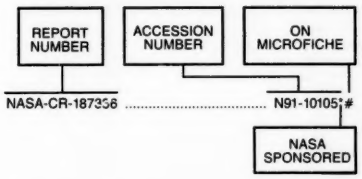

Listings in this index are arranged alphanumerically by contract number. Under each contract number the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The accession number denotes the number by which the citation is identified.


AERO-0003-C ..... N91-32430
AF PROJ. 1123 ..... N91-32773
AF PROJ. 2567 ..... N91-32072
AF PROJ. 7755 ..... N91-32754
AF-AFOSR-0093-91 ..... N91-32610
A84/KM/80 ..... N91-32813
A87/D/149 ..... N91-32753
N91-32812
A87/KM/172 ..... N91-32862
A89/K/659 ..... N91-32396
A89/KL/121 ..... N91-32477
BMVG-T/RF42/G022/G1412 ..... N91-32434
B239503 ..... N91-32633
CNES-CEA-844/87/4757/00 ..... N91-32346
DA PROJ. 161-62786-AH-98 ..... N91-32775
DAAA21-89-C-0176 ..... N91-32733
DAAL02-89-C-0075 ..... N91-32726
DAAL03-88-K-0085 ..... N91-32845
DE-AC0S-84OR-21400 ..... N91-32844
DE-AC02-76CH-00016 ..... N91-32160
N91-32211
N91-32585
N91-32889
N91-32893
N91-32907
N91-32920
N91-32927
N91-32972
N91-32978
DE-AC02-76CH-03000 ..... N91-32414
N91-32849
N91-33032
N91-33040
DE-AC02-83CH-10093 ..... N91-32575
DE-AC03-76SF-00098 ..... N91-32195
N91-32210
N91-32404
N91-32455
N91-32586
N91-32749
N91-32835
N91-32866
N91-32879
N91-32880
N91-32909
N91-32915
N91-32958
N91-32992
DE-AC03-76SF-00515 ..... N91-32883
N91-32906
N91-32910
DE-AC03-89ER-51114 ..... N91-32949
DE-AC03-89ER-52153 ..... N91-32952
DE-AC04-76DP-00613 ..... N91-32226
N91-32500
DE-AC04-76DP-00789 ..... N91-32089
N91-32150
N91-32157
N91-32194
N91-32199
N91-32219
N91-32220
N91-32233
N91-32289
N91-32399
N91-32400
N91-32403
N91-32406
N91-32453
N91-32490
N91-32574
N91-32843
N91-32858
N91-32908
N91-32942
N91-32944
N91-32959
N91-32962
N91-32976
N91-32977
N91-33002
DE-AC04-76EV-01013 ..... N91-32750
N91-32770
DE-AC05-84OR-21400 ..... N91-32179
N91-32209
N91-32214
N91-32220
N91-32222
N91-32228
N91-32239
N91-32285
N91-32418
N91-32419
N91-32456
N91-32629
N91-32741
N91-32774
N91-32834
N91-32842
N91-32867
N91-32869
N91-32870
N91-32881
N91-32884
N91-32891
N91-32899
N91-32902
N91-32903
N91-32950
N91-32960
N91-32971
N91-32991
DE-AC05-84OS-21400 ..... N91-32513
DE-AC06-76RL-01830 ..... N91-32168
N91-32169
N91-32212
N91-32408
N91-32576
N91-32577
N91-32756
DE-AC06-76RL-01831 ..... N91-32212
DE-AC06-87RL-10930 ..... N91-32990
DE-AC07-76ID-01570 ..... N91-32218
DE-AC08-88NV-10617 ..... N91-32405
N91-32407
N91-32475
N91-32983
DE-AC22-88PC-88948 ..... N91-32454
DE-AC22-90PC-90044 ..... N91-32193
DE-AC35-89ER-40486 ..... N91-32868
DE-AI01-87ER-13656 ..... N91-32897
DE-AI09-80ET-47927 ..... N91-32225
DE-AS05-76ER-04930 ..... N91-32877
DE-FG01-90CE-15459 ..... N91-32235
DE-FG02-85ER-25001 ..... N91-32865
DE-FG02-85ER-40231 ..... N91-32895
DE-FG02-86ER-13620 ..... N91-32751
DE-FG02-86ER-60417 ..... N91-32894
DE-FG02-87ER-13791 ..... N91-32896
DE-FG02-88ER-13822 ..... N91-32198
DE-FG02-88ER-45376 ..... N91-32206
N91-32207
DE-FG02-89ER-14024 ..... N91-32578
DE-FG02-89ER-69017 ..... N91-32742
DE-FG02-90ER-14104 ..... N91-32416
DE-FG02-90ER-14147 ..... N91-32466
DE-FG02-91ER-40626 ..... N91-33041
DE-FG02-91ER-54111 ..... N91-32935
DE-FG03-86ER-60490 ..... N91-32587
DE-FG03-87ER-13727 ..... N91-32948
DE-FG03-87ER-13738 ..... N91-32984
DE-FG03-87ER-13757 ..... N91-32465
DE-FG03-88ER-13892 ..... N91-32205
DE-FG03-90ER-54089 ..... N91-32941
DE-FG05-80ET-53088 ..... N91-32464
N91-32945
N91-32946
DE-FG05-88ER-40399 ..... N91-32887
DE-FG05-89ER-40421 ..... N91-33016
N91-33017
DE-FG06-86ER-45273 ..... N91-32485
DE-FG06-87ER-25045 ..... N91-32833
DE-FG06-88ER-40427 ..... N91-32890
DE-FG07-89ER-12901 ..... N91-32186
DE-FG22-87PC-79923 ..... N91-32192
DE-FG22-88PC-88928 ..... N91-32939
DI-14-08-0001-G-1656 ..... N91-32740
DI-14-12-0001-30073 ..... N91-32746
DRET-88-229 ..... N91-32871
DRET-89-34-001 ..... N91-32435
N91-32437
DTCG23-88-R-20020 ..... N91-32522
DTEA03-89-P-01022 ..... N91-32284
DTFA01-87-C-00014 ..... N91-32086
DTFA03-87-A-00021 ..... N91-32602
DTRS57-89-P-82291 ..... N91-32832
E-EG-1448-301 ..... N91-32655
E-EG-1448-303 ..... N91-32657
N91-32658
ESTEC-8058/88/NL/RE(SC) ..... N91-32311
ESTEC-8093/88/NL/SK ..... N91-32340
F04701-90-C-0023 ..... N91-32651
F49620-87-C-0116 ..... N91-32155
G-GU-2789-303 ..... N91-32655
GRI-5084-238-1302 ..... N91-32178
GRI-5086-260-1249 ..... N91-32190
GRI-5086-260-1326 ..... N91-32191
GRI-5086-260-1398 ..... N91-32570
GRI-5087-260-1613 ..... N91-32594
JPL-957723 ..... N91-33043
MDA972-88-J-1006 ..... N91-32958
NAGW-1504 ..... N91-33042
NAGW-2022 ..... N91-33046
NAG1-363 ..... N91-32078
N91-32462
NAG1-423 ..... N91-32078
NAG1-872 ..... N91-32079
NAG1-946 ..... N91-32155
NAG1-1018 ..... N91-32519
NAG1-1070 ..... N91-32080
NAG1-1211 ..... N91-32187
NAG3-519 ..... N91-32556
NAG3-901 ..... N91-32523
NAG3-946 ..... N91-32237
NAG3-1100 ..... N91-33014
NAG3-1192 ..... N91-32442
NAG5-931 ..... N91-32288
NAG5-1053 ..... N91-32512
NAG5-1055 ..... N91-32280
NAG8-66 ..... N91-32678
NAG8-751 ..... N91-32609
NAG8-760 ..... N91-32672
NAG8-836 ..... N91-32691
NAG8-877 ..... N91-33045
NAL10-0049 ..... N91-32610
NASA ORDER C-60376-P ..... N91-32840
NASA ORDER C-99066-G ..... N91-32460
NASA ORDER T-0604L ..... N91-32092
NASA ORDER T-0704F ..... N91-32282
NAS1-17432 ..... N91-32231
NAS1-18465 ..... N91-32088
NAS1-18533 ..... N91-32200
NAS1-18586 ..... N91-32132
N91-32853
NAS1-18599 ..... N91-32527
NAS1-18605 ..... N91-32463
NAS3-24105 ..... N91-32141

NAS3-24389 ..... N91-32524
NAS3-24635 ..... N91-32561
NAS3-25063 ..... N91-32166
NAS3-25266 ..... N91-32075
N91-32077
N91-32474
N91-33046
NAS3-25270 ..... N91-32138
NAS5-28765 ..... N91-32591
NAS7-918 ..... N91-32489
N91-32509
N91-32510
N91-32805
N91-32923
N91-32924
N91-32925
N91-32926
NAS8-32488 ..... N91-32579
NAS8-36955 ..... N91-32221
N91-32236
NAS8-37127 ..... N91-32691
NAS8-38083 ..... N91-32497
NAS9-18492 ..... N91-32776
NCC1-100 ..... N91-32441
NCC2-387 ..... N91-32472
N91-32545
N91-32797
N91-32798
N91-32799
N91-32800
N91-32801
N91-32802
N91-32814
N91-32815
N91-32816
N91-32817
N91-32818
N91-32819
N91-32820
N91-32821
N91-32822
N91-32836
N91-32844
N91-32845
N91-32846
N91-32847
N91-32848
N91-32859
N91-32864
N91-32865
N91-33005
NCC2-408 ..... N91-32797
N91-32798
N91-32836
NCC9-16 ..... N91-32803
N91-32804
N91-32823
N91-32824
N91-32825
N91-32826
N91-32827
N91-32828
N91-32829
N91-32830
N91-32837
N91-32838
N91-32839
NERC-GR3/5896 ..... N91-32710
NSF AST-89-01685 ..... N91-33016
N91-33017
NSF ATM-82-05468 ..... N91-32609
NSF ATM-82-18621 ..... N91-32609
NSF ATM-86-00526 ..... N91-32609
NSF ATM-89-19697 ..... N91-32609
NSF BCS-89-08688 ..... N91-32747
NSF DMS-87-14612 ..... N91-32845
NSF ISI-90-60142 ..... N91-32562
NSG-377 ..... N91-32180
N00014-88-C-0391 ..... N91-32562
N00173-90-M-9744 ..... N91-33016
N91-33017
RICIS PROJ. ET-14 ..... N91-32826
RICIS PROJ. ET-23 ..... N91-32823
N91-32827
N91-32830
RICIS PROJ. IM-15 ..... N91-32803
N91-32804
RICIS PROJ. IM-19 ..... N91-32824
RICIS PROJ. SE-19 ..... N91-32837
N91-32838
N91-32839
RICIS PROJ. SE-25 ..... N91-32828
N91-32829
RICIS PROJ. SE-35 ..... N91-32825
SWRI PROJ. 05-3515 ..... N91-32823
N91-32830
SWRI PROJ. 15-4865-009 ..... N91-32579
USAF-SPC-90-4005 ..... N91-32710
W-31-109-ENG-38 ..... N91-32213
N91-32232
N91-32476
N91-32505
N91-32506
N91-32744
N91-32752
N91-32757
N91-32833
N91-32854
N91-32860
N91-32888
N91-32928
N91-32965
N91-32966
N91-32967
N91-32968
N91-32969
N91-32974
N91-32975
N91-32981
N91-32982
N91-32986
N91-32987
N91-32988
N91-32989
W-7405-ENG-36 ..... N91-32189
N91-32208
N91-32397
N91-32407
N91-32452
N91-32478
N91-32479
N91-32480
N91-32484
N91-32491
N91-32492
N91-32493
N91-32573
N91-32582
N91-32590
N91-32855
N91-32856
N91-32863
N91-32878
N91-32882
N91-32891
N91-32892
N91-32900
N91-32901
N91-32904
N91-32905
N91-32912
N91-32921
N91-32936
N91-32937
N91-32938
N91-32953
N91-32961
N91-33049
W-7405-ENG-48 ..... N91-32151
N91-32197
N91-32220
N91-32227
N91-32238
N91-32286
N91-32401
N91-32402
N91-32409
N91-32413
N91-32415
N91-32417
N91-32457
N91-32467
N91-32473
N91-32481
N91-32482
N91-32483
N91-32486
N91-32487
N91-32490
N91-32501
N91-32502
N91-32503
N91-32504
N91-32544
N91-32572
N91-32588
N91-32589
N91-32743
N91-32758
N91-32885
N91-32886
N91-32898
N91-32911
N91-32916
N91-32917
N91-32918
N91-32919
N91-32940
N91-32951
N91-32958
N91-32970
N91-32973
N91-32979
N91-32980
N91-32985
N91-33038
N91-33039
N91-33051
N91-33053
W-7405-ENG-82 ..... N91-32943
N91-32963
N91-32964
188-78-60 ..... N91-33033
310-10-63-90-01 ..... N91-32251
310-20-65-63-00 ..... N91-32267
N91-32268
310-20-65-86-04 ..... N91-32252
310-20-65-91-00 ..... N91-32253
310-20-66-09-01 ..... N91-32254
N91-32255
310-20-66-87-02 ..... N91-32256
310-20-67-59-00 ..... N91-32257
310-20-67-63-00 ..... N91-32258
310-20-67-91-01 ..... N91-32259
310-30-69-88-04 ..... N91-32269
N91-32270
N91-32271
310-30-69-91-05 ..... N91-32272
310-30-70-84-02 ..... N91-32260
N91-32261
310-30-70-87-06 ..... N91-32262
310-30-70-89-01 ..... N91-32263
310-30-71-83-04 ..... N91-32264
N91-32266
310-30-72-88-01 ..... N91-32265
314-30-41-11-10 ..... N91-32274
314-30-43-20-52 ..... N91-32276
314-30-69-40-06 ..... N91-32277
314-40-21-30-02 ..... N91-32278
314-40-31-30-03 ..... N91-32279
314-40-41-11-06 ..... N91-32273
N91-32275
316-30-19 ..... N91-32287
505-59-36 ..... N91-32134
505-59-52 ..... N91-32145
505-61-91 ..... N91-32071
505-62-00 ..... N91-32474
505-62-21 ..... N91-32458
N91-32459
N91-32460
505-62-50 ..... N91-32143
505-62-52 ..... N91-32074
N91-32440
505-63-5B ..... N91-32180
N91-32181
N91-32182
505-63-01-01 ..... N91-32231
505-63-36-01 ..... N91-32519
505-63-50-02 ..... N91-32200
505-63-50-04 ..... N91-32527
505-63-53 ..... N91-32526
505-64-10 ..... N91-32132
505-64-12-51 ..... N91-32088
505-64-13 ..... N91-32135
505-66-41-41 ..... N91-32853
505-66-71 ..... N91-32850
505-67-00 ..... N91-32798
505-68-71 ..... N91-32070
505-69-50 ..... N91-32141
505-90-00 ..... N91-33013
505-90-51 ..... N91-32204
505-90-52 ..... N91-32215
505-90-52-01 ..... N91-32463
505-90-52-02 ..... N91-32841
506-40-91-02 ..... N91-32441
506-41-11 ..... N91-32237
N91-33046
506-41-21 ..... N91-32549
506-41-41 ..... N91-32177
N91-33014
506-42-31 ..... N91-32158
N91-32162
506-42-73 ..... N91-32161
506-43-11 ..... N91-32216
509-10-02-03 ..... N91-32084
510-01-0A ..... N91-32520
510-01-50 ..... N91-32523
533-02-36 ..... N91-32140

| | |
|---|---|
| 535-03-10 | N91-32075 |
| | N91-32138 |
| 535-05-10 | N91-32077 |
| 553-13-00 | N91-32524 |
| 573-01-21-04 | N91-32528 |
| 590-13-11 | N91-32569 |
| 590-13-31 | N91-32410 |
| | N91-32412 |
| 590-21-41 | N91-32163 |
| 593-21-21 | N91-32166 |
| 643-10-01 | N91-32247 |
| 946-01-00-78 | N91-32155 |

### Typical Report Number Index Listing




Listings in this index are arranged alphanumerically by report number. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.


A-90146 ..... N91-32070* #
A-90266 ..... N91-32071* #
A-90293 ..... N91-32528* #
A-91020 ..... N91-32145* #
A-91076 ..... N91-33033* #
A-91157 ..... N91-32134* #
A-91192 ..... N91-32135* #

AAAF-NT-89-20 ..... N91-32073 #

AAS-91-445 ..... N91-32157 #

AD-A229487 ..... N91-32130 #
AD-A229518 ..... N91-32136 #
AD-A229520 ..... N91-32775 #
AD-A229617 ..... N91-32993 #
AD-A229622 ..... N91-32137 #
AD-A229624 ..... N91-33004 #
AD-A229633 ..... N91-32857 #
AD-A229634 ..... N91-32518 #
AD-A234252 ..... N91-32072 #
AD-A239444 ..... N91-32081 #
AD-A239456 ..... N91-32773 #
AD-A239458 ..... N91-32754 #
AD-A239469 ..... N91-32796 #
AD-A239536 ..... N91-32521 #

AD-D014948 ..... N91-32398 #
AD-D014949 ..... N91-32470 #
AD-D014952 ..... N91-32471 #
AD-D014953 ..... N91-32224 #

AD-E900925 ..... N91-32857 #

AFIT/EN-TR-90-07 ..... N91-32130 #

AFIT/GIR/LSM/90D-9 ..... N91-33004 #

AFIT/GLM/RQ/90S-49 ..... N91-32137 #

AFIT/GSM/LSY/90S-5 ..... N91-32993 #

AGARD-AR-271 ..... N91-32082 #
AGARD-AR-291 ..... N91-32443 #

AGARD-LS-172 ..... N91-32241 #
AGARD-LS-175 ..... N91-32759 #

AGARD-29 ..... N91-32851* #

AIAA-90-2552 ..... N91-32164* #
AIAA-91-2117 ..... N91-32158* #
AIAA-91-2133 ..... N91-32077* #
AIAA-91-2792 ..... N91-32143* #
AIAA-91-3525 ..... N91-32410* #
AIAA-91-3533 ..... N91-32247* #
AIAA-91-3553 ..... N91-32161* #
AIAA-91-3568 ..... N91-32162* #
AIAA-91-3589 ..... N91-32287* #
AIAA-91-3602 ..... N91-32163* #

AL-TR-1991-0005 ..... N91-32773 #

ANL-HEP-CP-90-99 ..... N91-32888 #

ANL-TRANS-90-16 ..... N91-32476 #

ANL-91/27 ..... N91-32213 #

ANL/CP-71880 ..... N91-32888 #
ANL/CP-72519 ..... N91-32505 #
ANL/CP-72549 ..... N91-32965 #
ANL/CP-72553 ..... N91-32928 #
ANL/CP-72561 ..... N91-32966 #
ANL/CP-72661 ..... N91-32974 #
ANL/CP-72870 ..... N91-32975 #
ANL/CP-72980 ..... N91-32982 #
ANL/CP-72996 ..... N91-32969 #
ANL/CP-72998 ..... N91-32968 #
ANL/CP-73057 ..... N91-32988 #
ANL/CP-73384 ..... N91-32981 #
ANL/CP-73599 ..... N91-32833 #
ANL/CP-73645 ..... N91-32967 #
ANL/CP-73656 ..... N91-32752 #
ANL/CP-73728 ..... N91-32506 #
ANL/CP-73809 ..... N91-32744 #
ANL/CP-73886 ..... N91-32987 #
ANL/CP-73887 ..... N91-32986 #
ANL/CP-73910 ..... N91-32854 #
ANL/CP-73929 ..... N91-32989 #

ANL/EAIS-2 ..... N91-32757 #

ANL/EAIS/TM-52 ..... N91-32860 #

ANL/FE-91/1 ..... N91-32232 #

AR-005-606 ..... N91-32146 #

ARCCB-MR-90029 ..... N91-32518 #

ARE-TM(UHR)-91305 ..... N91-32424 #

ARL-PROP-R-180 ..... N91-32146 #

ASA-S2/222 ..... N91-32521 #

BCRS-90-37 ..... N91-32469 #

BNL-45740 ..... N91-32160 #
BNL-46240-REV ..... N91-32585 #
BNL-46408 ..... N91-32972 #
BNL-46409 ..... N91-32893 #
BNL-46414 ..... N91-32978 #
BNL-46442 ..... N91-32889 #
BNL-46468 ..... N91-32211 #
BNL-46471 ..... N91-32907 #
BNL-46496 ..... N91-32927 #
BNL-46497 ..... N91-32920 #

BR300555 ..... N91-32424 #

BUMINES-RI-9329 ..... N91-32499 #

CAM-9002 ..... N91-32178 #

CMOTT-91-06 ..... N91-32460* #

CONF-900388-5 ..... N91-32910 #
CONF-900466-101 ..... N91-32220 #
CONF-900527-3 ..... N91-32958 #
CONF-900814-19 ..... N91-32886 #
CONF-900833-16 ..... N91-32586 #
CONF-901035-21 ..... N91-32211 #
CONF-901057-30 ..... N91-33038 #
CONF-901145-1 ..... N91-32970 #
CONF-901188-3 ..... N91-32898 #
CONF-901263-10 ..... N91-32207 #
CONF-910116-22 ..... N91-32186 #
CONF-910250-1 ..... N91-32464 #
CONF-910326-6 ..... N91-32833 #
CONF-910326-7 ..... N91-32834 #
CONF-910326-8 ..... N91-32744 #
CONF-910344-2 ..... N91-32404 #

CONF-910373-15 ..... N91-32849 #
CONF-910406-34 ..... N91-32920 #
CONF-910430-18 ..... N91-32227 #
CONF-910430-21 ..... N91-32985 #
CONF-910450-15 ..... N91-32544 #
CONF-910505-388 ..... N91-32909 #
CONF-910505-398 ..... N91-32907 #
CONF-910580-4 ..... N91-32971 #
CONF-910615-6 ..... N91-32952 #
CONF-910626-3 ..... N91-32937 #
CONF-910626-5 ..... N91-32503 #
CONF-910626-6 ..... N91-32490 #
CONF-910640-31 ..... N91-32286 #
CONF-910640-32 ..... N91-32413 #
CONF-910640-33 ..... N91-32402 #
CONF-910640-34 ..... N91-32482 #
CONF-910640-36 ..... N91-32401 #
CONF-910640-39 ..... N91-32403 #
CONF-910640-40 ..... N91-32409 #
CONF-910640-41 ..... N91-32415 #
CONF-910646-3 ..... N91-32977 #
CONF-910646-5 ..... N91-32962 #
CONF-910706-3 ..... N91-32878 #
CONF-910707-2 ..... N91-32960 #
CONF-910707-6 ..... N91-32981 #
CONF-910710-2 ..... N91-32972 #
CONF-910710-3 ..... N91-32987 #
CONF-910715-2 ..... N91-32965 #
CONF-910730-5 ..... N91-32974 #
CONF-910730-6 ..... N91-32982 #
CONF-910730-7 ..... N91-32975 #
CONF-910730-9 ..... N91-32927 #
CONF-910736-6 ..... N91-32959 #
CONF-910736-9 ..... N91-32966 #
CONF-910736-10 ..... N91-32967 #
CONF-910736-11 ..... N91-32968 #
CONF-910736-13 ..... N91-32969 #
CONF-910736-15 ..... N91-32973 #
CONF-910736-16 ..... N91-32988 #
CONF-910746-3 ..... N91-32884 #
CONF-910774-52 ..... N91-32399 #
CONF-910774-58 ..... N91-32089 #
CONF-910774-65 ..... N91-32936 #
CONF-910801-17 ..... N91-32239 #
CONF-910801-18 ..... N91-32168 #
CONF-910801-19 ..... N91-32408 #
CONF-910801-20 ..... N91-32576 #
CONF-910801-21 ..... N91-32169 #
CONF-910802-1 ..... N91-32577 #
CONF-910803-1 ..... N91-32991 #
CONF-910808-4 ..... N91-32212 #
CONF-910809-2 ..... N91-32588 #
CONF-910815-2 ..... N91-32899 #
CONF-910824-1 ..... N91-32863 #
CONF-910857-1 ..... N91-32908 #
CONF-910857-2 ..... N91-32942 #
CONF-910857-3 ..... N91-32953 #
CONF-910862-2 ..... N91-32208 #
CONF-910869-1 ..... N91-32950 #
CONF-910903-9 ..... N91-32902 #
CONF-910903-10 ..... N91-32419 #
CONF-910907-5 ..... N91-32199 #
CONF-910927-1 ..... N91-32506 #
CONF-911001-2 ..... N91-32774 #
CONF-911003-5 ..... N91-32944 #
CONF-911003-6 ..... N91-32209 #
CONF-911025-2 ..... N91-32197 #
CONF-911047-6 ..... N91-32573 #
CONF-911071-2 ..... N91-32990 #
CONF-911084-2 ..... N91-32228 #
CONF-911087-2 ..... N91-32285 #
CONF-8906411-1 ..... N91-32743 #
CONF-9003100 ..... N91-32891 #
CONF-9008162-2-REV ..... N91-32585 #
CONF-9009315-6 ..... N91-32888 #
CONF-9010405-1 ..... N91-32770 #
CONF-9012104-1 ..... N91-32889 #
CONF-9101100-5 ..... N91-32417 #
CONF-9103110-2 ..... N91-32481 #
CONF-9103112-4 ..... N91-32397 #
CONF-9103193-1 ..... N91-32961 #
CONF-9103194-1 ..... N91-32473 #
CONF-9103197-1 ..... N91-33040 #

CONF-9103198-1 ..... N91-32750 #
CONF-9104164-6 ..... N91-32487 #
CONF-9104164-7 ..... N91-32885 #
CONF-9104201-2 ..... N91-32893 #
CONF-9104288-1 ..... N91-33049 #
CONF-9105106-23 ..... N91-32904 #
CONF-9105114-1 ..... N91-32916 #
CONF-9105114-2 ..... N91-32918 #
CONF-9105130-6 ..... N91-32979 #
CONF-9105217-2 ..... N91-32854 #
CONF-9105222-2 ..... N91-32890 #
CONF-9105225-3 ..... N91-32912 #
CONF-9105238-1 ..... N91-32881 #
CONF-9105238-4 ..... N91-32906 #
CONF-9105239-1 ..... N91-32880 #
CONF-9105241-1 ..... N91-32883 #
CONF-9105242-1 ..... N91-32452 #
CONF-9105243-2 ..... N91-33051 #
CONF-9106122-4 ..... N91-33032 #
CONF-9106145-2 ..... N91-32219 #
CONF-9106176-5 ..... N91-32195 #
CONF-9106185-2 ..... N91-32980 #
CONF-9106194-2 ..... N91-32900 #
CONF-9106194-5 ..... N91-32901 #
CONF-9106222-6 ..... N91-32457 #
CONF-9106222-8 ..... N91-32467 #
CONF-9106241-2 ..... N91-32978 #
CONF-9106256-1 ..... N91-32882 #
CONF-9106260-1 ..... N91-32905 #
CONF-9106262-1 ..... N91-32867 #
CONF-9106266-1 ..... N91-32151 #
CONF-9106267-1 ..... N91-32589 #
CONF-9107105-50 ..... N91-32233 #
CONF-9107115-17 ..... N91-32407 #
CONF-9107115-19 ..... N91-32478 #
CONF-9107115-21 ..... N91-32917 #
CONF-9107115-22 ..... N91-32479 #
CONF-9107115-24 ..... N91-32915 #
CONF-9107115-27 ..... N91-32835 #
CONF-9107115-28 ..... N91-32475 #
CONF-9107115-30 ..... N91-32483 #
CONF-9107115-31 ..... N91-32919 #
CONF-9107115-33 ..... N91-32983 #
CONF-9107115-39 ..... N91-32491 #
CONF-9107115-40 ..... N91-32492 #
CONF-9107115-41 ..... N91-32928 #
CONF-9107128-1 ..... N91-32892 #
CONF-9107136-4 ..... N91-32756 #
CONF-9107143-2 ..... N91-32989 #
CONF-9107155-1 ..... N91-32903 #
CONF-9107158-1 ..... N91-32214 #
CONF-9107160-1 ..... N91-32992 #
CONF-9107163-1 ..... N91-32752 #
CONF-9108108-1 ..... N91-32418 #
CONF-9108118-1 ..... N91-32484 #
CONF-9108118-2 ..... N91-32493 #
CONF-9108121-1 ..... N91-32289 #
CONF-9108126-1 ..... N91-32157 #
CONF-9108127-1 ..... N91-32453 #
CONF-9108128-1 ..... N91-32194 #
CONF-9108143-1 ..... N91-32986 #
CONF-9109108-6 ..... N91-32938 #
CONF-9109121-1 ..... N91-32870 #
CONF-9109208-2 ..... N91-32976 #
CONF-9109226-5 ..... N91-32480 #
CONF-9109226-6 ..... N91-32150 #
CONF-9109226-8 ..... N91-32160 #
CONF-9109227-1 ..... N91-32858 #
CONF-9109229-1 ..... N91-32179 #
CONF-9109230-1 ..... N91-32189 #
CONF-9109230-2 ..... N91-32406 #
CONF-9109230-3 ..... N91-32855 #
CONF-9109232-1 ..... N91-32921 #
CONF-9109233-1 ..... N91-32501 #
CONF-9109233-2 ..... N91-32502 #
CONF-9109235-1 ..... N91-32400 #
CONF-9109236-1 ..... N91-32500 #
CONF-9109242-1 ..... N91-32911 #
CONF-9109243-1 ..... N91-32505 #
CONF-9109248-1 ..... N91-32856 #
CONF-9109249-1 ..... N91-32590 #
CONF-9110169-1 ..... N91-32582 #
CONF-9110171-2 ..... N91-33002 #
CONF-9110173-1 ..... N91-32842 #

CRANFIELD-AERO-9108 ..... N91-32772 #

CRIF-MT-180 ..... N91-32496 #

CSTB-2-89-003-4 ..... N91-32871 #

DE90-015633 ..... N91-32958 #
DE91-002164 ..... N91-32575 #
DE91-013428 ..... N91-33012 #
DE91-014180 ..... N91-32571 #
DE91-015602 ..... N91-32222 #
DE91-015677 ..... N91-32886 #
DE91-015717 ..... N91-32238 #
DE91-015759 ..... N91-32235 #
DE91-015763 ..... N91-32286 #
DE91-015779 ..... N91-32756 #
DE91-015812 ..... N91-32218 #
DE91-015842 ..... N91-32585 #
DE91-015916 ..... N91-32179 #
DE91-015927 ..... N91-32285 #
DE91-015929 ..... N91-32960 #
DE91-016010 ..... N91-32904 #
DE91-016017 ..... N91-32479 #
DE91-016018 ..... N91-32961 #
DE91-016027 ..... N91-32573 #
DE91-016028 ..... N91-32452 #
DE91-016042 ..... N91-33049 #
DE91-016048 ..... N91-32883 #
DE91-016070 ..... N91-32892 #
DE91-016072 ..... N91-32938 #
DE91-016075 ..... N91-32905 #
DE91-016093 ..... N91-32921 #
DE91-016113 ..... N91-32858 #
DE91-016117 ..... N91-33002 #
DE91-016118 ..... N91-32962 #
DE91-016160 ..... N91-32963 #
DE91-016161 ..... N91-32964 #
DE91-016188 ..... N91-32089 #
DE91-016189 ..... N91-32399 #
DE91-016190 ..... N91-32289 #
DE91-016192 ..... N91-32977 #
DE91-016196 ..... N91-32407 #
DE91-016198 ..... N91-32397 #
DE91-016199 ..... N91-32208 #
DE91-016201 ..... N91-32959 #
DE91-016224 ..... N91-32209 #
DE91-016225 ..... N91-32903 #
DE91-016236 ..... N91-32478 #
DE91-016239 ..... N91-32878 #
DE91-016240 ..... N91-32863 #
DE91-016246 ..... N91-32586 #
DE91-016250 ..... N91-32879 #
DE91-016254 ..... N91-32210 #
DE91-016255 ..... N91-32749 #
DE91-016257 ..... N91-32880 #
DE91-016266 ..... N91-32909 #
DE91-016278 ..... N91-32881 #
DE91-016290 ..... N91-32935 #
DE91-016292 ..... N91-32205 #
DE91-016303 ..... N91-32582 #
DE91-016305 ..... N91-32484 #
DE91-016309 ..... N91-32882 #
DE91-016310 ..... N91-32189 #
DE91-016315 ..... N91-32936 #
DE91-016321 ..... N91-32937 #
DE91-016323 ..... N91-32480 #
DE91-016344 ..... N91-32206 #
DE91-016345 ..... N91-32207 #
DE91-016399 ..... N91-32943 #
DE91-016402 ..... N91-32400 #
DE91-016403 ..... N91-32219 #
DE91-016413 ..... N91-32225* #
DE91-016429 ..... N91-32915 #
DE91-016430 ..... N91-32992 #
DE91-016432 ..... N91-32866 #
DE91-016454 ..... N91-32500 #
DE91-016469 ..... N91-33032 #
DE91-016481 ..... N91-32226 #
DE91-016487 ..... N91-32887 #
DE91-016499 ..... N91-32574 #
DE91-016511 ..... N91-32197 #
DE91-016514 ..... N91-32888 #
DE91-016515 ..... N91-32833 #
DE91-016520 ..... N91-32506 #
DE91-016521 ..... N91-32965 #
DE91-016523 ..... N91-32966 #
DE91-016524 ..... N91-32967 #
DE91-016525 ..... N91-32968 #
DE91-016528 ..... N91-32969 #
DE91-016553 ..... N91-32401 #
DE91-016555 ..... N91-32481 #
DE91-016558 ..... N91-32413 #
DE91-016559 ..... N91-32402 #
DE91-016560 ..... N91-32482 #
DE91-016561 ..... N91-33038 #
DE91-016562 ..... N91-32501 #
DE91-016567 ..... N91-32502 #
DE91-016568 ..... N91-32503 #
DE91-016569 ..... N91-32473 #
DE91-016570 ..... N91-32916 #
DE91-016571 ..... N91-32917 #
DE91-016586 ..... N91-32192 #
DE91-016596 ..... N91-32193 #
DE91-016604 ..... N91-32227 #
DE91-016605 ..... N91-32918 #
DE91-016608 ..... N91-33051 #
DE91-016609 ..... N91-32970 #
DE91-016641 ..... N91-32403 #
DE91-016646 ..... N91-32194 #
DE91-016647 ..... N91-32944 #
DE91-016649 ..... N91-32453 #
DE91-016707 ..... N91-32150 #
DE91-016708 ..... N91-32157 #
DE91-016734 ..... N91-32990 #
DE91-016759 ..... N91-32214 #
DE91-016760 ..... N91-32971 #
DE91-016767 ..... N91-32228 #
DE91-016768 ..... N91-32884 #
DE91-016771 ..... N91-32842 #
DE91-016773 ..... N91-32834 #
DE91-016774 ..... N91-32991 #
DE91-016814 ..... N91-32757 #
DE91-016825 ..... N91-32741 #
DE91-016829 ..... N91-32939 #
DE91-016842 ..... N91-32751 #
DE91-016873 ..... N91-32572 #
DE91-016877 ..... N91-32454 #
DE91-016893 ..... N91-32978 #
DE91-016894 ..... N91-32893 #
DE91-016895 ..... N91-32972 #
DE91-016898 ..... N91-32160 #
DE91-016903 ..... N91-32742 #
DE91-016907 ..... N91-32894 #
DE91-016910 ..... N91-32889 #
DE91-016937 ..... N91-32895 #
DE91-016950 ..... N91-32485 #
DE91-016951 ..... N91-32890 #
DE91-016964 ..... N91-32198 #
DE91-016980 ..... N91-32195 #
DE91-016982 ..... N91-32835 #
DE91-016988 ..... N91-32404 #
DE91-017007 ..... N91-32211 #
DE91-017011 ..... N91-32455 #
DE91-017071 ..... N91-33039 #
DE91-017072 ..... N91-32504 #
DE91-017074 ..... N91-32940 #
DE91-017077 ..... N91-32486 #
DE91-017082 ..... N91-32979 #
DE91-017083 ..... N91-32151 #
DE91-017085 ..... N91-32483 #
DE91-017087 ..... N91-32885 #
DE91-017088 ..... N91-32487 #
DE91-017093 ..... N91-32919 #
DE91-017094 ..... N91-32973 #
DE91-017128 ..... N91-32906 #
DE91-017130 ..... N91-32910 #
DE91-017131 ..... N91-32456 #
DE91-017132 ..... N91-33053 #
DE91-017151 ..... N91-32239 #
DE91-017152 ..... N91-32867 #
DE91-017156 ..... N91-32907 #
DE91-017220 ..... N91-32414 #
DE91-017228 ..... N91-32220 #
DE91-017241 ..... N91-32860 #
DE91-017245 ..... N91-32774 #
DE91-017287 ..... N91-32168 #
DE91-017301 ..... N91-32752 #
DE91-017305 ..... N91-32974 #
DE91-017306 ..... N91-32505 #
DE91-017320 ..... N91-32981 #
DE91-017322 ..... N91-32982 #
DE91-017324 ..... N91-32975 #
DE91-017359 ..... N91-32849 #
DE91-017379 ..... N91-33040 #
DE91-017385 ..... N91-32464 #
DE91-017386 ..... N91-32945 #
DE91-017388 ..... N91-32946 #
DE91-017396 ..... N91-32983 #
DE91-017399 ..... N91-32475 #
DE91-017400 ..... N91-32405 #
DE91-017401 ..... N91-32465 #
DE91-017402 ..... N91-32984 #
DE91-017403 ..... N91-32587 #
DE91-017404 ..... N91-32948 #
DE91-017412 ..... N91-32941 #
DE91-017413 ..... N91-32896 #
DE91-017415 ..... N91-32466 #
DE91-017418 ..... N91-32212 #
DE91-017425 ..... N91-32408 #
DE91-017428 ..... N91-32544 #
DE91-017431 ..... N91-32980 #
DE91-017432 ..... N91-32409 #
DE91-017445 ..... N91-32743 #
DE91-017449 ..... N91-32942 #
DE91-017450 ..... N91-32908 #
DE91-017451 ..... N91-32406 #
DE91-017455 ..... N91-32490 #
DE91-017458 ..... N91-32976 #
DE91-017459 ..... N91-32199 #
DE91-017464 ..... N91-32911 #
DE91-017472 ..... N91-32920 #
DE91-017480 ..... N91-32927 #
DE91-017484 ..... N91-32750 #

DE91-017516 ..... N91-32770 #
DE91-017533 ..... N91-32169 #
DE91-017534 ..... N91-32576 #
DE91-017535 ..... N91-32577 #
DE91-017544 ..... N91-32415 #
DE91-017545 ..... N91-32758 #
DE91-017550 ..... N91-32416 #
DE91-017556 ..... N91-32186 #
DE91-017559 ..... N91-32891 #
DE91-017595 ..... N91-32868 #
DE91-017600 ..... N91-32869 #
DE91-017649 ..... N91-32897 #
DE91-017651 ..... N91-32588 #
DE91-017654 ..... N91-32589 #
DE91-017655 ..... N91-32417 #
DE91-017656 ..... N91-32898 #
DE91-017657 ..... N91-32457 #
DE91-017661 ..... N91-32467 #
DE91-017665 ..... N91-32985 #
DE91-017687 ..... N91-32899 #
DE91-017710 ..... N91-32578 #
DE91-017715 ..... N91-32232 #
DE91-017717 ..... N91-32843 #
DE91-017730 ..... N91-33041 #
DE91-017765 ..... N91-32949 #
DE91-017820 ..... N91-32491 #
DE91-017822 ..... N91-32900 #
DE91-017824 ..... N91-32492 #
DE91-017828 ..... N91-32912 #
DE91-017829 ..... N91-32901 #
DE91-017838 ..... N91-32476 #
DE91-017846 ..... N91-32233 #
DE91-017848 ..... N91-32513 #
DE91-017866 ..... N91-32418 #
DE91-017868 ..... N91-32902 #
DE91-017870 ..... N91-32870 #
DE91-017872 ..... N91-32950 #
DE91-017920 ..... N91-32951 #
DE91-017938 ..... N91-32952 #
DE91-017947 ..... N91-32419 #
DE91-017963 ..... N91-32986 #
DE91-017967 ..... N91-32854 #
DE91-017968 ..... N91-32928 #
DE91-017976 ..... N91-32987 #
DE91-017977 ..... N91-32988 #
DE91-017991 ..... N91-32744 #
DE91-017997 ..... N91-32989 #
DE91-018035 ..... N91-32855 #
DE91-018036 ..... N91-32856 #
DE91-018039 ..... N91-32953 #
DE91-018045 ..... N91-32590 #
DE91-018048 ..... N91-32493 #
DE91-018182 ..... N91-32213 #
DE91-527088 ..... N91-32488 #

DLR-FB-90-47 ..... N91-32542 #
DLR-FB-90-55 ..... N91-32543 #
DLR-FB-90-57 ..... N91-32468 #
DLR-FB-91-02 ..... N91-32139 #
DLR-FB-91-03 ..... N91-32131 #
DLR-FB-91-08 ..... N91-32249 #
DLR-FB-91-11 ..... N91-32090 #
DLR-FB-91-12 ..... N91-32439 #
DLR-FB-91-14 ..... N91-32748 #
DLR-FB-91-15 ..... N91-32076 #

DLR-MITT-91-02 ..... N91-32159 #
DLR-MITT-91-03 ..... N91-32142 #
DLR-MITT-91-04 ..... N91-32568 #
DLR-MITT-91-05 ..... N91-32581 #
DLR-MITT-91-06 ..... N91-33001 #

DOD-4650.4 ..... N91-32091 #

DOE/CE-15459/T3 ..... N91-32235 #

DOE/EH-0186 ..... N91-33012 #

DOE/ER-13620/4 ..... N91-32751 #
DOE/ER-13656/T3 ..... N91-32897 #
DOE/ER-13727/T1 ..... N91-32948 #
DOE/ER-13738/T1 ..... N91-32984 #
DOE/ER-13757/T1 ..... N91-32465 #
DOE/ER-13791/5 ..... N91-32896 #
DOE/ER-13822/4 ..... N91-32198 #
DOE/ER-13892/T1 ..... N91-32205 #
DOE/ER-14024/2 ..... N91-32578 #
DOE/ER-14104/2 ..... N91-32416 #
DOE/ER-14147/1 ..... N91-32466 #
DOE/ER-40231/T11 ..... N91-32895 #
DOE/ER-40399/4 ..... N91-32887 #
DOE/ER-40427/12-N91 ..... N91-32890 #
DOE/ER-40626/1 ..... N91-33041 #
DOE/ER-45273/5 ..... N91-32485 #
DOE/ER-45376/3 ..... N91-32206 #
DOE/ER-54089/1 ..... N91-32941 #

DOE/ER-54111/1 ..... N91-32935 #
DOE/ER-60417/T3 ..... N91-32894 #
DOE/ER-60490/T1 ..... N91-32587 #
DOE/ER-69017/3 ..... N91-32742 #

DOE/ET-47927/T6 ..... N91-32225* #
DOE/ET-53088/492 ..... N91-32464 #
DOE/ET-53088/502 ..... N91-32945 #
DOE/ET-53088/508 ..... N91-32946 #

DOE/ID-10297 ..... N91-32218 #

DOE/OSTI-11633-3 ..... N91-32571 #

DOE/PC-79923/T7 ..... N91-32192 #
DOE/PC-88928/T4 ..... N91-32939 #
DOE/PC-88948/T1 ..... N91-32454 #
DOE/PC-90044/2 ..... N91-32193 #

DOT-HS-807688 ..... N91-32832 #

DOT-TSC-NHTSA-90-2 ..... N91-32832 #

DOT-VNTSC-RSPA-90-3 ..... N91-32091 #

DOT/FAA/CT-TN90/32 ..... N91-32284 #
DOT/FAA/CT-TN91/6 ..... N91-32282 #
DOT/FAA/CT-TN91/10 ..... N91-32092 #
DOT/FAA/CT-TN91/24 ..... N91-32283 #

DOT/FAA/RD-90/17 ..... N91-32086 #
DOT/FAA/RD-91/14 ..... N91-32088* #
DOT/FAA/RD-91/21 ..... N91-32093 #

D180-32725-2 ..... N91-32231* #

E-5233-1-PT-1 ..... N91-32458* #
E-6045-1-PT-2 ..... N91-32459* #
E-6089 ..... N91-32549* #
E-6091 ..... N91-32074* #
E-6120 ..... N91-32181* #
E-6183 ..... N91-32520* #
E-6308 ..... N91-32237* #
E-6370 ..... N91-32177* #
E-6381 ..... N91-32569* #
E-6420 ..... N91-32158* #
E-6437 ..... N91-32164* #
E-6465 ..... N91-33046* #
E-6503 ..... N91-32806* #
E-6504 ..... N91-32440* #
E-6515 ..... N91-32412* #
E-6516 ..... N91-32474* #
E-6521 ..... N91-32077* #
E-6540 ..... N91-32075* #
E-6551 ..... N91-32165* #
E-6553 ..... N91-32182* #
E-6560 ..... N91-32163* #
E-6563 ..... N91-32460* #
E-6564 ..... N91-32247* #
E-6569 ..... N91-32162* #
E-6573 ..... N91-32216* #
E-6577 ..... N91-32410* #
E-6583 ..... N91-32143* #
E-6585 ..... N91-32215* #
E-6586 ..... N91-32161* #
E-6598 ..... N91-32267* #
E-6606 ..... N91-32204* #
E-6631 ..... N91-33014* #

EGG-10617-2086 ..... N91-32983 #
EGG-10617-2102 ..... N91-32405 #
EGG-10617-2107 ..... N91-32407 #
EGG-10617-4117 ..... N91-32475 #

EPA/600/9-91/020 ..... N91-32583 #

ESA-PSS-01-612-ISSUE-1 ..... N91-32420 #
ESA-PSS-01-726-ISSUE-2 ..... N91-32421 #
ESA-PSS-01-728-ISSUE-2 ..... N91-32422 #
ESA-PSS-03-207-ISSUE-1 ..... N91-32176 #
ESA-PSS-03-210-ISSUE-1 ..... N91-32234 #
ESA-PSS-05-0-ISSUE-2 ..... N91-32811 #

ESA-SP-313 ..... N91-32291 #
ESA-SP-1125 ..... N91-32152 #

ESA-STR-231 ..... N91-32597 #

ESA-TT-1115 ..... N91-33034 #
ESA-TT-1266 ..... N91-32139 #
ESA-TT-1267 ..... N91-32131 #
ESA-TT-1268 ..... N91-32439 #
ESA-TT-1269 ..... N91-32748 #
ESA-TT-1270 ..... N91-33001 #

ESDP-3689 ..... N91-32741 #

ETN-88-92728 ..... N91-33034 #
ETN-91-90001 ..... N91-32246
ETN-91-90011 ..... N91-32994 #
ETN-91-90013 ..... N91-32129
ETN-91-90014 ..... N91-32547
ETN-91-90015 ..... N91-32596
ETN-91-90021 ..... N91-32174
ETN-91-90022 ..... N91-32808
ETN-91-90023 ..... N91-32809
ETN-91-90024 ..... N91-32810
ETN-91-90028 ..... N91-32435 #
ETN-91-90029 ..... N91-32437 #
ETN-91-90030 ..... N91-32159 #
ETN-91-90031 ..... N91-32142 #
ETN-91-90032 ..... N91-32568 #
ETN-91-90033 ..... N91-32581 #
ETN-91-90034 ..... N91-33001 #
ETN-91-90035 ..... N91-32542 #
ETN-91-90036 ..... N91-32543 #
ETN-91-90037 ..... N91-32468 #
ETN-91-90038 ..... N91-32139 #
ETN-91-90039 ..... N91-32131 #
ETN-91-90040 ..... N91-32249 #
ETN-91-90042 ..... N91-32090 #
ETN-91-90043 ..... N91-32439 #
ETN-91-90044 ..... N91-32748 #
ETN-91-90045 ..... N91-32076 #
ETN-91-90046 ..... N91-32914 #
ETN-91-90050 ..... N91-32469 #
ETN-91-90053 ..... N91-32203 #
ETN-91-90054 ..... N91-33015 #
ETN-91-90055 ..... N91-32188 #
ETN-91-90056 ..... N91-32148 #
ETN-91-90057 ..... N91-32548
ETN-91-90058 ..... N91-32175 #
ETN-91-90060 ..... N91-32223 #
ETN-91-90061 ..... N91-32176 #
ETN-91-90062 ..... N91-32811 #
ETN-91-90067 ..... N91-32152 #
ETN-91-90068 ..... N91-32420 #
ETN-91-90069 ..... N91-32421 #
ETN-91-90070 ..... N91-32422 #
ETN-91-90071 ..... N91-32234 #
ETN-91-90072 ..... N91-32597 #
ETN-91-90074 ..... N91-33034 #
ETN-91-99560 ..... N91-32291 #
ETN-91-99745 ..... N91-32496 #
ETN-91-99831 ..... N91-33052
ETN-91-99861 ..... N91-32424 #
ETN-91-99863 ..... N91-32248
ETN-91-99866 ..... N91-32395
ETN-91-99867 ..... N91-32872
ETN-91-99868 ..... N91-32147
ETN-91-99869 ..... N91-32873
ETN-91-99870 ..... N91-32874
ETN-91-99873 ..... N91-32875
ETN-91-99874 ..... N91-32201
ETN-91-99875 ..... N91-32202
ETN-91-99879 ..... N91-32425 #
ETN-91-99883 ..... N91-32876 #
ETN-91-99884 ..... N91-32877 #
ETN-91-99886 ..... N91-32580 #
ETN-91-99887 ..... N91-32745 #
ETN-91-99888 ..... N91-32807 #
ETN-91-99890 ..... N91-32861 #
ETN-91-99897 ..... N91-32772 #
ETN-91-99902 ..... N91-32426 #
ETN-91-99961 ..... N91-32073 #
ETN-91-99970 ..... N91-32871 #
ETN-91-99990 ..... N91-32753
ETN-91-99991 ..... N91-32812
ETN-91-99994 ..... N91-32862
ETN-91-99995 ..... N91-32477
ETN-91-99996 ..... N91-32813
ETN-91-99999 ..... N91-32396

FCR-11645A ..... N91-32570 #

FEL-89-A193 ..... N91-32862
FEL-90-A303 ..... N91-32477
FEL-90-A322 ..... N91-32813
FEL-91-A076 ..... N91-32396
FEL-91-B002 ..... N91-32246

FFI-91/4004 ..... N91-32203 #
FFI-91/5009 ..... N91-33015 #
FFI-91/6004 ..... N91-32188 #
FFI-91/6006 ..... N91-32148 #

FNAL-TM-1748 ..... N91-32414 #

FNAL/C-91/90 ..... N91-32849 #
FNAL/C-91/173 ..... N91-33032 #
FNAL/C-91/179-A ..... N91-33040 #

GA-A-20467 ..... N91-32952 #

GA-A-20558 ..... N91-32949 #

GRI-90/0205 ..... N91-32178 #
GRI-91/0050 ..... N91-32191 #
GRI-91/0073 ..... N91-32190 #
GRI-91/0138 ..... N91-32594 #
GRI-91/0139 ..... N91-32570 #

H-1727 ..... N91-32850* #
H-1745 ..... N91-32140* #
H-1761 ..... N91-32851* #

HDL-SR-91-5 ..... N91-32796 #

HIFAN-482 ..... N91-32909 #

IC-AERO-89-03 ..... N91-32425 #

ICASE-91-75 ..... N91-32463* #

ICOMP-91-16 ..... N91-32460* #

IFSR-492 ..... N91-32464 #
IFSR-502 ..... N91-32945 #
IFSR-508 ..... N91-32946 #

INFORME-I-520/90 ..... N91-32175 #
INFORME-I-536/90 ..... N91-32223 #

INT-PATENT-CLASS-A61F-2/58 ..... N91-32795*
INT-PATENT-CLASS-A61F-2/68 ..... N91-32795*

INT-PATENT-CLASS-B23K-26/00 ..... N91-32508*
INT-PATENT-CLASS-B61D-15/08 ..... N91-32514*
INT-PATENT-CLASS-B64D-1/12 ..... N91-32498*

INT-PATENT-CLASS-G01B-11/00 ..... N91-32922*
INT-PATENT-CLASS-G01N-25/50 ..... N91-32196*
INT-PATENT-CLASS-G01S-13/89 ..... N91-32546*
INT-PATENT-CLASS-G06G-7/12 ..... N91-32852*

IOS-275 ..... N91-32580 #
IOS-279 ..... N91-32745 #

IS-T-1552 ..... N91-32943 #
IS-T-1559 ..... N91-32964 #
IS-T-1565 ..... N91-32963 #

ISBN-0-309-04381-6 ..... N91-33016* #
ISBN-0-309-04383-2 ..... N91-33017* #
ISBN-1-871564-29-8 ..... N91-32772 #
ISBN-2-7170-0953-1 ..... N91-32073 #
ISBN-3-7696-9409-0 ..... N91-32129
ISBN-3-7696-9410-4 ..... N91-32547
ISBN-3-88148-263-6 ..... N91-32596
ISBN-92-835-0569-7 ..... N91-32241 #
ISBN-92-835-0625-1 ..... N91-32443 #
ISBN-92-835-0634-0 ..... N91-32759 #
ISBN-92-9092-072-6 ..... N91-32152 #
ISBN-92-9092-094-7 ..... N91-32291 #
ISBN-92-9092-192-7 ..... N91-32597 #

ISSN-0065-5325 ..... N91-32129
ISSN-0065-5325 ..... N91-32547
ISSN-0071-9196 ..... N91-32548
ISSN-0072-4130 ..... N91-32596
ISSN-0143-7305 ..... N91-32395
ISSN-0143-7305 ..... N91-32872
ISSN-0143-7313 ..... N91-32201
ISSN-0176-7739 ..... N91-32142 #
ISSN-0243-0177 ..... N91-32073 #
ISSN-0262-5369 ..... N91-32808
ISSN-0262-5369 ..... N91-32809
ISSN-0262-5369 ..... N91-32810
ISSN-0289-260X ..... N91-32032 #
ISSN-0308-7247 ..... N91-32425 #
ISSN-0309-3069 ..... N91-32248
ISSN-0377-8312 ..... N91-32426 #
ISSN-0379-4059 ..... N91-32176 #
ISSN-0379-4059 ..... N91-32234 #
ISSN-0379-4059 ..... N91-32420 #
ISSN-0379-4059 ..... N91-32421 #
ISSN-0379-4059 ..... N91-32422 #
ISSN-0379-4059 ..... N91-32811 #
ISSN-0379-4067 ..... N91-32597 #
ISSN-0379-6566 ..... N91-32152 #
ISSN-0722-0359 ..... N91-33052
ISSN-0723-1903 ..... N91-33052
ISSN-0802-2437 ..... N91-32148 #
ISSN-0802-2437 ..... N91-32188 #
ISSN-0802-2437 ..... N91-32203 #
ISSN-0802-2437 ..... N91-33015 #
ISSN-0915-633X ..... N91-32592 #
ISSN-0915-633X ..... N91-32913 #
ISSN-0915-633X ..... N91-32929 #
ISSN-0915-633X ..... N91-32930 #
ISSN-0915-633X ..... N91-32931 #
ISSN-0915-633X ..... N91-32932 #
ISSN-0915-633X ..... N91-32933 #
ISSN-0915-633X ..... N91-32934 #
ISSN-0915-633X ..... N91-32954 #
ISSN-0915-633X ..... N91-32955 #
ISSN-0915-633X ..... N91-32956 #
ISSN-0915-633X ..... N91-32957 #
ISSN-0930-9276 ..... N91-32994 #
ISSN-0939-298X ..... N91-32159 #
ISSN-0939-298X ..... N91-32568 #
ISSN-0939-298X ..... N91-32581 #
ISSN-0939-298X ..... N91-33001 #
ISSN-0939-2963 ..... N91-32076 #
ISSN-0939-2963 ..... N91-32090 #
ISSN-0939-2963 ..... N91-32131 #
ISSN-0939-2963 ..... N91-32139 #
ISSN-0939-2963 ..... N91-32249 #
ISSN-0939-2963 ..... N91-32439 #
ISSN-0939-2963 ..... N91-32468 #
ISSN-0939-2963 ..... N91-32542 #
ISSN-0939-2963 ..... N91-32543 #
ISSN-0939-2963 ..... N91-32748 #
ISSN-0955-9655 ..... N91-32147
ISSN-0955-9655 ..... N91-32873
ISSN-0955-9655 ..... N91-32874
ISSN-0955-9655 ..... N91-32875
ISSN-0959-2423 ..... N91-32174
ISSN-0959-2423 ..... N91-32202

IVO-A-05/90 ..... N91-32488 #

IZF-1991-A-10 ..... N91-32753
IZF-1991-A-12 ..... N91-32812

JPL-TDA-PR-42-106 ..... N91-32250* #

KCP-613-4369 ..... N91-32226 #
KCP-613-4560 ..... N91-32500 #

KGRD-24 ..... N91-32747 #

L-16932 ..... N91-32841* #

LA-UR-91-1123 ..... N91-32921 #
LA-UR-91-2196 ..... N91-32905 #
LA-UR-91-2242 ..... N91-32938 #
LA-UR-91-2257 ..... N91-32892 #
LA-UR-91-2267 ..... N91-33049 #
LA-UR-91-2330 ..... N91-32452 #
LA-UR-91-2338 ..... N91-32573 #
LA-UR-91-2381 ..... N91-32961 #
LA-UR-91-2383 ..... N91-32479 #
LA-UR-91-2400 ..... N91-32959 #
LA-UR-91-2407 ..... N91-32904 #
LA-UR-91-2417 ..... N91-32208 #
LA-UR-91-2422 ..... N91-32397 #
LA-UR-91-2431 ..... N91-32407 #
LA-UR-91-2441 ..... N91-32863 #
LA-UR-91-2443 ..... N91-32878 #
LA-UR-91-2462 ..... N91-32478 #
LA-UR-91-2495 ..... N91-32480 #
LA-UR-91-2498 ..... N91-32937 #
LA-UR-91-2509 ..... N91-32936 #
LA-UR-91-2535 ..... N91-32189 #
LA-UR-91-2538 ..... N91-32492 #
LA-UR-91-2540 ..... N91-32882 #
LA-UR-91-2549 ..... N91-32484 #
LA-UR-91-2561 ..... N91-32582 #
LA-UR-91-2564 ..... N91-32900 #
LA-UR-91-2589 ..... N91-32491 #
LA-UR-91-2704 ..... N91-32856 #
LA-UR-91-2705 ..... N91-32855 #
LA-UR-91-2747 ..... N91-32953 #
LA-UR-91-2754 ..... N91-32493 #
LA-UR-91-2762 ..... N91-32590 #
LA-UR-91-2827 ..... N91-32901 #
LA-UR-91-2846 ..... N91-32912 #

LA-12146-C ..... N91-32891 #

LBL-29216 ..... N91-32958 #
LBL-29224 ..... N91-32586 #
LBL-30029 ..... N91-32909 #
LBL-30634 ..... N91-32866 #
LBL-30682 ..... N91-32749 #
LBL-30696 ..... N91-32404 #
LBL-30801 ..... N91-32880 #
LBL-30832 ..... N91-32210 #
LBL-30889 ..... N91-32835 #
LBL-30890 ..... N91-32992 #
LBL-30901 ..... N91-32879 #
LBL-30916 ..... N91-32195 #
LBL-30920 ..... N91-32915 #
LBL-30963 ..... N91-32455 #
LC-90-2346 ..... N91-32499 #
LC-90-21659 ..... N91-33016* #
LC-90-63608 ..... N91-33017* #

LLNL-M-089-REV-8 ..... N91-32238 #

M-669 ..... N91-32660* #

MATHS-REPT-A-143 ..... N91-32807 #
MATHS-REPT-A-149 ..... N91-32861 #

MCR-91-1333 ..... N91-32166* #

ME/ES-TR-91-4 ..... N91-32512* #

MIT-TR-47 ..... N91-32840

NAL-SP-14 ..... N91-32032 #

NAS 1.15:4305 ..... N91-32841* #
NAS 1.15:4328 ..... N91-32140* #
NAS 1.15:102818 ..... N91-32070* #
NAS 1.15:102859 ..... N91-32071* #
NAS 1.15:102889 ..... N91-32145* #
NAS 1.15:103551 ..... N91-32217* #
NAS 1.15:103553 ..... N91-32185* #
NAS 1.15:103840 ..... N91-33033* #
NAS 1.15:103867 ..... N91-32134* #
NAS 1.15:103885 ..... N91-32135* #
NAS 1.15:104095 ..... N91-33013* #
NAS 1.15:104108 ..... N91-32526* #
NAS 1.15:104143 ..... N91-32084* #
NAS 1.15:104234 ..... N91-32850* #
NAS 1.15:104242 ..... N91-32851* #
NAS 1.15:104346 ..... N91-32181* #
NAS 1.15:104378 ..... N91-32520* #
NAS 1.15:104507 ..... N91-32177* #
NAS 1.15:104512 ..... N91-32569* #
NAS 1.15:104740 ..... N91-32776* #
NAS 1.15:105102 ..... N91-32085* #
NAS 1.15:105106 ..... N91-32225* #
NAS 1.15:105145 ..... N91-32158* #
NAS 1.15:105152 ..... N91-32164* #
NAS 1.15:105200 ..... N91-32806* #
NAS 1.15:105201 ..... N91-32440* #
NAS 1.15:105205 ..... N91-32412* #
NAS 1.15:105208 ..... N91-32458* #
NAS 1.15:105209 ..... N91-32459* #
NAS 1.15:105216 ..... N91-33046* #
NAS 1.15:105223 ..... N91-32075* #
NAS 1.15:105225 ..... N91-32074* #
NAS 1.15:105228 ..... N91-32165* #
NAS 1.15:105230 ..... N91-32182* #
NAS 1.15:105235 ..... N91-32163* #
NAS 1.15:105238 ..... N91-32460* #
NAS 1.15:105239 ..... N91-32247* #
NAS 1.15:105242 ..... N91-32162* #
NAS 1.15:105248 ..... N91-32410* #
NAS 1.15:105254 ..... N91-32143* #
NAS 1.15:105256 ..... N91-32161* #
NAS 1.15:105275 ..... N91-32287* #
NAS 1.15:105280 ..... N91-32215* #
NAS 1.15:105282 ..... N91-32204* #
NAS 1.15:105292 ..... N91-32216* #
NAS 1.15:105293 ..... N91-33014* #
NAS 1.26:4393 ..... N91-32155* #
NAS 1.26:4398 ..... N91-32088* #
NAS 1.26:4403 ..... N91-32853* #
NAS 1.26:183493 ..... N91-32591* #
NAS 1.26:184200 ..... N91-32497* #
NAS 1.26:184201 ..... N91-32579* #
NAS 1.26:184219 ..... N91-32221* #
NAS 1.26:184238 ..... N91-32236* #
NAS 1.26:185876 ..... N91-32865* #
NAS 1.26:186616 ..... N91-32797* #
NAS 1.26:187129 ..... N91-32138* #
NAS 1.26:187144 ..... N91-32237* #
NAS 1.26:187194 ..... N91-32474* #
NAS 1.26:187195 ..... N91-32077* #
NAS 1.26:187196 ..... N91-32524* #
NAS 1.26:187208 ..... N91-32141* #
NAS 1.26:187212 ..... N91-32523* #
NAS 1.26:187220 ..... N91-32180* #
NAS 1.26:187230 ..... N91-32166* #
NAS 1.26:187436 ..... N91-32798* #
NAS 1.26:187526 ..... N91-32132* #
NAS 1.26:187548 ..... N91-32231* #
NAS 1.26:187575 ..... N91-32200* #
NAS 1.26:187597 ..... N91-32519* #
NAS 1.26:187599 ..... N91-32527* #
NAS 1.26:187617 ..... N91-32441* #
NAS 1.26:187629 ..... N91-32463* #
NAS 1.26:187719 ..... N91-32864* #
NAS 1.26:188122 ..... N91-32822* #
NAS 1.26:188226 ..... N91-33016* #
NAS 1.26:188785 ..... N91-33017* #

NAS 1.26:188789 ..... N91-33042* #
NAS 1.26:188798 ..... N91-32187* #
NAS 1.26:188813 ..... N91-32250* #
NAS 1.26:188815 ..... N91-32823* #
NAS 1.26:188820 ..... N91-32078* #
NAS 1.26:188821 ..... N91-32830* #
NAS 1.26:188823 ..... N91-32829* #
NAS 1.26:188824 ..... N91-32828* #
NAS 1.26:188827 ..... N91-32827* #
NAS 1.26:188828 ..... N91-32826* #
NAS 1.26:188829 ..... N91-32804* #
NAS 1.26:188830 ..... N91-32803* #
NAS 1.26:188831 ..... N91-32825* #
NAS 1.26:188832 ..... N91-32824* #
NAS 1.26:188851 ..... N91-32845* #
NAS 1.26:188857 ..... N91-32814* #
NAS 1.26:188859 ..... N91-32815* #
NAS 1.26:188861 ..... N91-32846* #
NAS 1.26:188862 ..... N91-32816* #
NAS 1.26:188864 ..... N91-32799* #
NAS 1.26:188865 ..... N91-32859* #
NAS 1.26:188866 ..... N91-32800* #
NAS 1.26:188874 ..... N91-32844* #
NAS 1.26:188875 ..... N91-32847* #
NAS 1.26:188876 ..... N91-32801* #
NAS 1.26:188877 ..... N91-32280* #
NAS 1.26:188879 ..... N91-32817* #
NAS 1.26:188882 ..... N91-32818* #
NAS 1.26:188885 ..... N91-33005* #
NAS 1.26:188886 ..... N91-32819* #
NAS 1.26:188888 ..... N91-32848* #
NAS 1.26:188889 ..... N91-32820* #
NAS 1.26:188890 ..... N91-32802* #
NAS 1.26:188891 ..... N91-32821* #
NAS 1.26:188902 ..... N91-32472* #
NAS 1.26:188916 ..... N91-32442* #
NAS 1.26:188918 ..... N91-33043* #
NAS 1.26:188919 ..... N91-32080* #
NAS 1.26:188920 ..... N91-32079* #
NAS 1.26:188924 ..... N91-33045* #
NAS 1.26:188925 ..... N91-32462* #
NAS 1.26:188930 ..... N91-32837* #
NAS 1.26:188935 ..... N91-32836* #
NAS 1.26:188937 ..... N91-32545* #
NAS 1.26:188941 ..... N91-32838* #
NAS 1.26:188942 ..... N91-32839* #
NAS 1.26:188956 ..... N91-32512* #
NAS 1.26:188959 ..... N91-32288* #
NAS 1.55:3106-VOL-1 ..... N91-32599* #
NAS 1.55:3106-VOL-2 ..... N91-32693* #
NAS 1.55:3114 ..... N91-32528* #
NAS 1.55:3125 ..... N91-32549* #
NAS 1.55:3126 ..... N91-32660* #
NAS 1.71:LAR-14352-1 ..... N91-32511* #
NAS 1.71:LAR-14424-1-SB ..... N91-32149* #
NAS 1.71:LEW-15043-1 ..... N91-32230* #
NAS 1.71:LEW-15164-2 ..... N91-32229* #
NAS 1.71:LEW-15200-1 ..... N91-32167* #
NAS 1.71:MSC-21631-1 ..... N91-32947* #
NAS 1.71:NPO-17632-1-CU ..... N91-32805* #
NAS 1.71:NPO-18095-1-CU ..... N91-32923* #
NAS 1.71:NPO-18116-1-CU ..... N91-32509* #
NAS 1.71:NPO-18134-1-CU ..... N91-32510* #
NAS 1.71:NPO-18194-1-CU ..... N91-32924* #
NAS 1.71:NPO-18243-1-CU ..... N91-32489* #
NAS 1.71:NPO-18278-1-CU ..... N91-32925* #
NAS 1.71:NPO-18317-1-CU ..... N91-32926* #
NAS 1.71:SSC-00013-1 ..... N91-32515* #

NASA-CASE-GSC-13212-1 ..... N91-32546*

NASA-CASE-LAR-14352-1 ..... N91-32511* #
NASA-CASE-LAR-14424-1-SB ..... N91-32149* #
NASA-CASE-LAR-14454-1 ..... N91-32196*

NASA-CASE-LEW-15043-1 ..... N91-32230* #
NASA-CASE-LEW-15164-2 ..... N91-32229* #
NASA-CASE-LEW-15200-1 ..... N91-32167* #

NASA-CASE-MFS-28426-1 ..... N91-32795*

NASA-CASE-MSC-21299-2 ..... N91-32508*
NASA-CASE-MSC-21416-1 ..... N91-32922*
NASA-CASE-MSC-21540-1 ..... N91-32514*
NASA-CASE-MSC-21631-1 ..... N91-32947* #
NASA-CASE-MSC-21671-1 ..... N91-32498*

NASA-CASE-NPO-16635-1-CU ..... N91-32240*
NASA-CASE-NPO-17632-1-CU ..... N91-32805* #
NASA-CASE-NPO-17664-1-CU ..... N91-32852*
NASA-CASE-NPO-18095-1-CU ..... N91-32923* #
NASA-CASE-NPO-18116-1-CU ..... N91-32509* #
NASA-CASE-NPO-18134-1-CU ..... N91-32510* #
NASA-CASE-NPO-18194-1-CU ..... N91-32924* #
NASA-CASE-NPO-18243-1-CU ..... N91-32489* #
NASA-CASE-NPO-18278-1-CU ..... N91-32925* #
NASA-CASE-NPO-18317-1-CU ..... N91-32926* #

NASA-CASE-SSC-00013-1 ..... N91-32515* #

NASA-CP-3106-VOL-1 ..... N91-32599* #
NASA-CP-3106-VOL-2 ..... N91-32693* #
NASA-CP-3114 ..... N91-32528* #
NASA-CP-3125 ..... N91-32549* #
NASA-CP-3126 ..... N91-32660* #

NASA-CR-4393 ..... N91-32155* #
NASA-CR-4398 ..... N91-32088* #
NASA-CR-4403 ..... N91-32853* #
NASA-CR-183493 ..... N91-32591* #
NASA-CR-184200 ..... N91-32497* #
NASA-CR-184201 ..... N91-32579* #
NASA-CR-184219 ..... N91-32221* #
NASA-CR-184238 ..... N91-32236* #
NASA-CR-185876 ..... N91-32865* #
NASA-CR-186616 ..... N91-32797* #
NASA-CR-187129 ..... N91-32138* #
NASA-CR-187144 ..... N91-32237* #
NASA-CR-187194 ..... N91-32474* #
NASA-CR-187195 ..... N91-32077* #
NASA-CR-187196 ..... N91-32524* #
NASA-CR-187208 ..... N91-32141* #
NASA-CR-187212 ..... N91-32523* #
NASA-CR-187220 ..... N91-32180* #
NASA-CR-187230 ..... N91-32166* #
NASA-CR-187436 ..... N91-32798* #
NASA-CR-187526 ..... N91-32132* #
NASA-CR-187548 ..... N91-32231* #
NASA-CR-187575 ..... N91-32200* #
NASA-CR-187597 ..... N91-32519* #
NASA-CR-187599 ..... N91-32527* #
NASA-CR-187617 ..... N91-32441* #
NASA-CR-187629 ..... N91-32463* #
NASA-CR-187719 ..... N91-32864* #
NASA-CR-188122 ..... N91-32822* #
NASA-CR-188226 ..... N91-33016* #
NASA-CR-188785 ..... N91-33017* #
NASA-CR-188789 ..... N91-33042* #
NASA-CR-188798 ..... N91-32187* #
NASA-CR-188813 ..... N91-32250* #
NASA-CR-188815 ..... N91-32823* #
NASA-CR-188820 ..... N91-32078* #
NASA-CR-188821 ..... N91-32830* #
NASA-CR-188823 ..... N91-32829* #
NASA-CR-188824 ..... N91-32828* #
NASA-CR-188827 ..... N91-32827* #
NASA-CR-188828 ..... N91-32826* #
NASA-CR-188829 ..... N91-32804* #
NASA-CR-188830 ..... N91-32803* #
NASA-CR-188831 ..... N91-32825* #
NASA-CR-188832 ..... N91-32824* #
NASA-CR-188851 ..... N91-32845* #
NASA-CR-188857 ..... N91-32814* #
NASA-CR-188859 ..... N91-32815* #
NASA-CR-188861 ..... N91-32846* #
NASA-CR-188862 ..... N91-32816* #
NASA-CR-188864 ..... N91-32799* #
NASA-CR-188865 ..... N91-32859* #
NASA-CR-188866 ..... N91-32800* #
NASA-CR-188874 ..... N91-32844* #
NASA-CR-188875 ..... N91-32847* #
NASA-CR-188876 ..... N91-32801* #
NASA-CR-188877 ..... N91-32280* #
NASA-CR-188879 ..... N91-32817* #
NASA-CR-188882 ..... N91-32818* #
NASA-CR-188885 ..... N91-33005* #
NASA-CR-188886 ..... N91-32819* #
NASA-CR-188888 ..... N91-32848* #
NASA-CR-188889 ..... N91-32820* #
NASA-CR-188890 ..... N91-32802* #
NASA-CR-188891 ..... N91-32821* #
NASA-CR-188902 ..... N91-32472* #
NASA-CR-188916 ..... N91-32442* #
NASA-CR-188918 ..... N91-33043* #
NASA-CR-188919 ..... N91-32080* #
NASA-CR-188920 ..... N91-32079* #
NASA-CR-188924 ..... N91-33045* #
NASA-CR-188925 ..... N91-32462* #
NASA-CR-188930 ..... N91-32837* #
NASA-CR-188935 ..... N91-32836* #
NASA-CR-188937 ..... N91-32545* #
NASA-CR-188941 ..... N91-32838* #
NASA-CR-188942 ..... N91-32839* #
NASA-CR-188956 ..... N91-32512* #
NASA-CR-188959 ..... N91-32288* #

NASA-TM-4305 ..... N91-32841* #
NASA-TM-4328 ..... N91-32140* #
NASA-TM-102818 ..... N91-32070* #
NASA-TM-102859 ..... N91-32071* #
NASA-TM-102889 ..... N91-32145* #
NASA-TM-103551 ..... N91-32217* #
NASA-TM-103553 ..... N91-32185* #
NASA-TM-103840 ..... N91-33033* #
NASA-TM-103867 ..... N91-32134* #
NASA-TM-103885 ..... N91-32135* #
NASA-TM-104095 ..... N91-33013* #
NASA-TM-104108 ..... N91-32526* #
NASA-TM-104143 ..... N91-32084* #
NASA-TM-104234 ..... N91-32850* #
NASA-TM-104242 ..... N91-32851* #
NASA-TM-104346 ..... N91-32181* #
NASA-TM-104378 ..... N91-32520* #
NASA-TM-104507 ..... N91-32177* #
NASA-TM-104512 ..... N91-32569* #
NASA-TM-104740 ..... N91-32776* #
NASA-TM-105102 ..... N91-32085* #
NASA-TM-105106 ..... N91-32225* #
NASA-TM-105145 ..... N91-32158* #
NASA-TM-105152 ..... N91-32164* #
NASA-TM-105200 ..... N91-32806* #
NASA-TM-105201 ..... N91-32440* #
NASA-TM-105205 ..... N91-32412* #
NASA-TM-105208 ..... N91-32458* #
NASA-TM-105209 ..... N91-32459* #
NASA-TM-105216 ..... N91-33046* #
NASA-TM-105223 ..... N91-32075* #
NASA-TM-105225 ..... N91-32074* #
NASA-TM-105228 ..... N91-32165* #
NASA-TM-105230 ..... N91-32182* #
NASA-TM-105235 ..... N91-32163* #
NASA-TM-105238 ..... N91-32460* #
NASA-TM-105239 ..... N91-32247* #
NASA-TM-105242 ..... N91-32162* #
NASA-TM-105248 ..... N91-32410* #
NASA-TM-105254 ..... N91-32143* #
NASA-TM-105256 ..... N91-32161* #
NASA-TM-105275 ..... N91-32287* #
NASA-TM-105280 ..... N91-32215* #
NASA-TM-105282 ..... N91-32204* #
NASA-TM-105292 ..... N91-32216* #
NASA-TM-105293 ..... N91-33014* #

NASA-91-003 ..... N91-32288* #

NATICK/TR/90/054 ..... N91-32775 #

NCAR/TN-359+STR ..... N91-32133 #

NIFS-19 ..... N91-32913 #
NIFS-26 ..... N91-32956 #
NIFS-27 ..... N91-32955 #
NIFS-28 ..... N91-32954 #
NIFS-84 ..... N91-32957 #
NIFS-91 ..... N91-32929 #
NIFS-92 ..... N91-32930 #
NIFS-93 ..... N91-32931 #
NIFS-96 ..... N91-32932 #
NIFS-97 ..... N91-32933 #
NIFS-98 ..... N91-32934 #
NIFS-99 ..... N91-32592 #

NIKHEF-K/AMPS/91-01 ..... N91-32914 #

NOAA-NWS-WRCP-62 ..... N91-32831 #

NOAA-TM-NWS-NSSFC-29 ..... N91-32738 #

NPL-DES-105 ..... N91-32395
NPL-DES-107 ..... N91-32872

NPL-DITC-171/91 ..... N91-32808
NPL-DITC-172/91 ..... N91-32809
NPL-DITC-173/91 ..... N91-32810

NPL-DMM(A)-7-PT-2 ..... N91-32174
NPL-DMM(A)-13 ..... N91-32201
NPL-DMM(A)-14 ..... N91-32202

NPL-MOM-103 ..... N91-32248

NPL-RSA(EXT)-15 ..... N91-32147
NPL-RSA(EXT)-16 ..... N91-32873
NPL-RSA(EXT)-17 ..... N91-32874
NPL-RSA(EXT)-20 ..... N91-32875

NTIA-91-27 ..... N91-32281 #

NTSB/AAR-91/04 ..... N91-32087 #

NWC-TP-7013 ..... N91-32857 #

OCS/MMS-90/0008 ..... N91-32746 #

ODU/ICAM-91-102 ..... N91-32462* #

ONERA-NT-1987-4 ..... N91-33034 #

ONERA-RSF-13/3637-AY ..... N91-32435 #
ONERA-RSF-20/3419-AY-124A ..... N91-32437 #

ORNL-CCIP-91-08 ..... N91-32877 #

ORNL/CDIAC-43 ..... N91-32741 #

ORNL/TM-11816 ..... N91-32222 #
ORNL/TM-11855-PT-2 ..... N91-32456 #
ORNL/TM-11902 ..... N91-32869 #

PB91-173351 ..... N91-32755 #
PB91-190868 ..... N91-32091 #
PB91-193375 ..... N91-33011 #
PB91-193441 ..... N91-32522 #
PB91-193508 ..... N91-33047 #
PB91-193516 ..... N91-33048 #
PB91-193656 ..... N91-32747 #
PB91-193920 ..... N91-32584 #
PB91-194142 ..... N91-32832 #
PB91-198168 ..... N91-32739 #
PB91-198176 ..... N91-32133 #
PB91-200543 ..... N91-32499 #
PB91-200709 ..... N91-32831 #
PB91-201020 ..... N91-33044 #
PB91-201392 ..... N91-32738 #
PB91-204529 ..... N91-33007 #
PB91-204537 ..... N91-33008 #
PB91-204545 ..... N91-33009 #
PB91-204552 ..... N91-33010 #
PB91-205716 ..... N91-32178 #
PB91-206391 ..... N91-32190 #
PB91-206417 ..... N91-32191 #
PB91-206458 ..... N91-32594 #
PB91-206615 ..... N91-32570 #
PB91-206656 ..... N91-32740 #
PB91-208454 ..... N91-32281 #
PB91-210666 ..... N91-32746 #
PB91-211847 ..... N91-32583 #
PB91-214056 ..... N91-33006 #
PB91-910404 ..... N91-32087 #

PNL-SA-18872 ..... N91-32576 #
PNL-SA-18894 ..... N91-32168 #
PNL-SA-18950 ..... N91-32169 #
PNL-SA-19016 ..... N91-32756 #
PNL-SA-19237 ..... N91-32212 #
PNL-SA-19257 ..... N91-32577 #
PNL-SA-19616 ..... N91-32408 #

RAL-91-010 ..... N91-32876 #
RAL-91-039 ..... N91-32877 #

RE-787 ..... N91-32200* #

REPT-10 ..... N91-33013* #

RIACS-TR-89-32 ..... N91-32814* #
RIACS-TR-89-36 ..... N91-32845* #
RIACS-TR-89-45 ..... N91-32472* #
RIACS-TR-90-2 ..... N91-32815* #
RIACS-TR-90-4 ..... N91-32798* #
RIACS-TR-90-5 ..... N91-32545* #
RIACS-TR-90-11 ..... N91-32797* #
RIACS-TR-90-20 ..... N91-32865* #
RIACS-TR-90-22 ..... N91-32864* #
RIACS-TR-90-25 ..... N91-32846* #
RIACS-TR-90-27 ..... N91-32816* #
RIACS-TR-90-28 ..... N91-32799* #
RIACS-TR-90-29 ..... N91-32859* #
RIACS-TR-90-30 ..... N91-32800* #
RIACS-TR-90-38 ..... N91-32844* #
RIACS-TR-90-39 ..... N91-32847* #
RIACS-TR-90-40 ..... N91-32801* #
RIACS-TR-90-44 ..... N91-32817* #
RIACS-TR-90-51 ..... N91-32818* #
RIACS-TR-91-04 ..... N91-32819* #
RIACS-TR-91-05 ..... N91-33005* #
RIACS-TR-91-07 ..... N91-32848* #
RIACS-TR-91-08 ..... N91-32802* #
RIACS-TR-91-09 ..... N91-32820* #
RIACS-TR-91-10 ..... N91-32836* #
RIACS-TR-91-11 ..... N91-32821* #
RIACS-TR-91-13 ..... N91-32822* #

S-646 ..... N91-32776* #

SAND-88-2291 ..... N91-32843 #
SAND-90-2881C ..... N91-32403 #
SAND-90-3213C ..... N91-32944 #
SAND-90-7036 ..... N91-32574 #
SAND-91-0041C ..... N91-32233 #
SAND-91-0116C ..... N91-32157 #
SAND-91-0282C ..... N91-32406 #
SAND-91-0633C ..... N91-32858 #
SAND-91-0840C ..... N91-32219 #
SAND-91-0863C ..... N91-32977 #
SAND-91-0864C ..... N91-32962 #
SAND-91-0914C ..... N91-32976 #
SAND-91-0998C ..... N91-32908 #
SAND-91-1019C ..... N91-32942 #
SAND-91-1248C ..... N91-32399 #
SAND-91-1348C ..... N91-32194 #
SAND-91-1391C ..... N91-32089 #
SAND-91-1402C ..... N91-32400 #
SAND-91-1504C ..... N91-32289 #
SAND-91-1593C ..... N91-32150 #
SAND-91-1614C ..... N91-32199 #
SAND-91-1623C ..... N91-32453 #
SAND-91-1687C ..... N91-32490 #
SAND-91-1703C ..... N91-32959 #
SAND-91-1719C ..... N91-33002 #

SCT-91RR-13 ..... N91-32086 #

SER-B-272-PT-2 ..... N91-32548

SER-C-361 ..... N91-32129
SER-C-362 ..... N91-32547

SERI/TP-262-4118 ..... N91-32575 #

SGD-560-PT-1 ..... N91-33047 #
SGD-560-PT-2 ..... N91-33048 #

SSC-363 ..... N91-32522 #

SSCL-472 ..... N91-32868 #

SU-SLAC-PUB-5601 ..... N91-32906 #
SU-SLAC-PUB-5608 ..... N91-32883 #

SU-SLAC-TN-91-6 ..... N91-32910 #

TD-90-3537 ..... N91-32477
TD-90-4057 ..... N91-32813
TD-90-4526 ..... N91-32862
TD-91-0038 ..... N91-32753
TD-91-0042 ..... N91-32812
TD-91-0412 ..... N91-32246
TD-91-0985 ..... N91-32396
TD-91-2196 ..... N91-32469 #

U-OF-IOWA-91-18 ..... N91-33043* #

UCB-PTH-91/24 ..... N91-32866 #
UCB-PTH-91/26 ..... N91-32880 #

UCRL-CR-103758-SUPPL ..... N91-32486 #
UCRL-CR-105166-1 ..... N91-32758 #
UCRL-CR-107473 ..... N91-32504 #
UCRL-CR-107841 ..... N91-33039 #
UCRL-CR-107988 ..... N91-32940 #

UCRL-JC-103342 ..... N91-32885 #
UCRL-JC-105034 ..... N91-33038 #
UCRL-JC-105079 ..... N91-32898 #
UCRL-JC-105250 ..... N91-32286 #
UCRL-JC-105355 ..... N91-32401 #
UCRL-JC-105398 ..... N91-32481 #
UCRL-JC-105422 ..... N91-32980 #
UCRL-JC-105473 ..... N91-32985 #
UCRL-JC-105474 ..... N91-32227 #
UCRL-JC-105582 ..... N91-32409 #
UCRL-JC-105661 ..... N91-32415 #
UCRL-JC-105739 ..... N91-32487 #
UCRL-JC-105815 ..... N91-32413 #
UCRL-JC-105816 ..... N91-32482 #
UCRL-JC-105818 ..... N91-32402 #
UCRL-JC-105846 ..... N91-32483 #
UCRL-JC-105883 ..... N91-32919 #
UCRL-JC-106792 ..... N91-32544 #
UCRL-JC-106849 ..... N91-32501 #
UCRL-JC-106853 ..... N91-32502 #
UCRL-JC-107009 ..... N91-32973 #
UCRL-JC-107417 ..... N91-32503 #
UCRL-JC-107423 ..... N91-32886 #
UCRL-JC-107436 ..... N91-32197 #
UCRL-JC-107488 ..... N91-32979 #
UCRL-JC-107583 ..... N91-32911 #
UCRL-JC-107770 ..... N91-32970 #
UCRL-JC-107782 ..... N91-32151 #
UCRL-JC-107888 ..... N91-32918 #
UCRL-JC-107889 ..... N91-32916 #
UCRL-JC-107980 ..... N91-33051 #
UCRL-JC-107990 ..... N91-32473 #
UCRL-JC-108014 ..... N91-32589 #
UCRL-JC-108032 ..... N91-32467 #
UCRL-JC-108033 ..... N91-32457 #
UCRL-JC-108038 ..... N91-32588 #
UCRL-JC-108076 ..... N91-32417 #
UCRL-JC-108077 ..... N91-32917 #
UCRL-LR-105821-91-2 ..... N91-32951 #
UCRL-LR-106135 ..... N91-33053 #

UCRL-52000-91-4 ..... N91-32572 #
UCRL-102260 ..... N91-32743 #

UMSI-91/66 ..... N91-32431 #

US PATENT-CLASS-75-338 ..... N91-32240*

US-PATENT-APPL-SN-176587 ..... N91-32508*
US-PATENT-APPL-SN-358029 ..... N91-32508*
US-PATENT-APPL-SN-391896 ..... N91-32546*
US-PATENT-APPL-SN-426345 ..... N91-32196*
US-PATENT-APPL-SN-463720 ..... N91-32852*
US-PATENT-APPL-SN-508154 ..... N91-32795*
US-PATENT-APPL-SN-527508 ..... N91-32514*
US-PATENT-APPL-SN-545177 ..... N91-32922*
US-PATENT-APPL-SN-558540 ..... N91-32398 #
US-PATENT-APPL-SN-593412 ..... N91-32196*
US-PATENT-APPL-SN-603337 ..... N91-32498*
US-PATENT-APPL-SN-620108 ..... N91-32470 #
US-PATENT-APPL-SN-636348 ..... N91-32471 #
US-PATENT-APPL-SN-665509 ..... N91-32923* #
US-PATENT-APPL-SN-699299 ..... N91-32509* #
US-PATENT-APPL-SN-700375 ..... N91-32224 #
US-PATENT-APPL-SN-700379 ..... N91-32924* #
US-PATENT-APPL-SN-710424 ..... N91-32489* #
US-PATENT-APPL-SN-712796 ..... N91-32805* #
US-PATENT-APPL-SN-722446 ..... N91-32167* #
US-PATENT-APPL-SN-729107 ..... N91-32947* #
US-PATENT-APPL-SN-735149 ..... N91-32511* #
US-PATENT-APPL-SN-740675 ..... N91-32515* #
US-PATENT-APPL-SN-743468 ..... N91-32149* #
US-PATENT-APPL-SN-744118 ..... N91-32510* #
US-PATENT-APPL-SN-744197 ..... N91-32926* #
US-PATENT-APPL-SN-747059 ..... N91-32925* #
US-PATENT-APPL-SN-766591 ..... N91-32229* #
US-PATENT-APPL-SN-772181 ..... N91-32230* #
US-PATENT-APPL-SN-858054 ..... N91-32240*

US-PATENT-CLASS-29-558 ..... N91-32508*
US-PATENT-CLASS-65-21.4 ..... N91-32240*
US-PATENT-CLASS-73-167 ..... N91-32196*
US-PATENT-CLASS-75-331 ..... N91-32240*
US-PATENT-CLASS-75-340 ..... N91-32240*
US-PATENT-CLASS-75-342 ..... N91-32240*
US-PATENT-CLASS-89-1.14 ..... N91-32498*
US-PATENT-CLASS-89-1.57 ..... N91-32498*
US-PATENT-CLASS-102-200 ..... N91-32196*
US-PATENT-CLASS-102-378 ..... N91-32498*
US-PATENT-CLASS-105-87 ..... N91-32514*
US-PATENT-CLASS-105-124 ..... N91-32514*
US-PATENT-CLASS-105-141 ..... N91-32514*
US-PATENT-CLASS-105-142 ..... N91-32514*
US-PATENT-CLASS-188-24.11 ..... N91-32514*
US-PATENT-CLASS-219-69.12 ..... N91-32508*
US-PATENT-CLASS-219-121.72 ..... N91-32508*
US-PATENT-CLASS-264-5 ..... N91-32240*
US-PATENT-CLASS-264-12 ..... N91-32240*
US-PATENT-CLASS-294-82.26 ..... N91-32498*
US-PATENT-CLASS-342-25 ..... N91-32546*
US-PATENT-CLASS-342-26 ..... N91-32546*
US-PATENT-CLASS-342-191 ..... N91-32546*
US-PATENT-CLASS-356-375 ..... N91-32922*
US-PATENT-CLASS-356-399 ..... N91-32922*
US-PATENT-CLASS-364-513 ..... N91-32852*
US-PATENT-CLASS-364-807 ..... N91-32852*
US-PATENT-CLASS-374-8 ..... N91-32196*
US-PATENT-CLASS-623-62 ..... N91-32795*
US-PATENT-CLASS-623-63 ..... N91-32795*

US-PATENT-5,021,065 ..... N91-32795*
US-PATENT-5,046,395 ..... N91-32498*
US-PATENT-5,051,559 ..... N91-32508*
US-PATENT-5,052,807 ..... N91-32922*
US-PATENT-5,052,817 ..... N91-32196*
US-PATENT-5,053,778 ..... N91-32546*
US-PATENT-5,055,240 ..... N91-32240*
US-PATENT-5,056,037 ..... N91-32852*
US-PATENT-5,058,506 ..... N91-32514*

USAAVSCOM-TR-90-A-008 ..... N91-32145* #

USAFSAM-SR-90-6 ..... N91-32754 #

USGS/G-1656 ..... N91-32740 #

UTK-91-003 ..... N91-32877 #

VKI-LS-1991-01 ..... N91-32426 #

WCAP-13 ..... N91-32659 #

WCDP-11 ..... N91-32598 #

WHC-SA-1132 ..... N91-32990 #

WL/MN-TR-91-23 ..... N91-32072 #

WMO/TD-359 ..... N91-32598 #
WMO/TD-385 ..... N91-32659 #

WRDC-TM-90-203-POTX ..... N91-32136 #

Y/DV-1100 ..... N91-32513 #

# Appendix

## NASA SCIENTIFIC AND TECHNICAL INFORMATION PROGRAM PRODUCTS AND SERVICES

The NASA Scientific and Technical Information (STI) Program provides for the collection and announcement of aerospace-related reports and literature obtained worldwide through agreements and exchanges. The result of the collection is the comprehensive NASA STI Database that covers aeronautics, space, and supporting disciplines.

The STI Database, documents generated or obtained by NASA, and products and services derived from or supporting the database are made available to the NASA research community and to the public. Descriptions and sources of these items are presented in the following pages.

*Scientific and Technical Aerospace Reports* (*STAR*) is an abstract journal, listing citations with abstracts for aerospace-related reports obtained from worldwide sources. *STAR* is issued on the 8th and 23rd of each month and announces current documents that have been entered into the NASA STI Database during the previous two weeks. The reports are of the following types:

- NASA, NASA contractor, and NASA grantee reports;
- Reports issued by other U.S. Government agencies, domestic and foreign institutions, universities, and private firms;
- Translations in report form;
- NASA-owned patents and patent applications;
- Other U.S. Government agency and foreign patents and patent applications;
- Domestic and foreign dissertations and theses.

Journal, book, and conference literature, journal translations, and certain foreign dissertations having the same subject scope as *STAR* are announced in a companion journal, *International Aerospace Abstracts* (*IAA*). *IAA* is issued on the 1st and 15th of each month and is available from the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, NY 10019.

## ELIGIBILITY AND REGISTRATION FOR NASA STI PRODUCTS AND SERVICES

Organizations of the type listed below that have registered with NASA can receive products and services.

- NASA offices and installations, contractors, subcontractors, grantees, and consultants;
- Other U.S. Government agencies and their contractors;
- Libraries in the United States that have arrangements with NASA to maintain collections of NASA documents for public reference;
- Other organizations in the United States having a need for NASA documents in work related to aeronautics and space research;
- Organizations abroad that have established reciprocal documents exchange arrangements with NASA.

Only the central service points or central points of document acquisition and control within qualified organizations are eligible to register for NASA STI products and services. Domestic organizations that may be eligible to receive various classes of NASA publications and services should address their requests for registration or further information to:

NASA Center for AeroSpace Information
ATTN: Registration Services
P.O. Box 8757
Baltimore, MD 21240-0757
301-621-0153

Organizations abroad should direct requests to:

National Aeronautics and Space Administration
Director, Scientific and Technical Information Program
Code JTT
Washington, DC 20546
USA
703-271-5640

## SUBJECT SCOPE

The subject scope of *STAR* and *IAA* includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are aiso covered.

## HOW TO USE *STAR* SUBJECT CATEGORIES

Abstracts in *STAR* are categorized by 10 major subject divisions that are divided further into 76 specific subject categories. The subject divisions and categories are listed in the Table of Contents together with a note for each that defines its scope and provides any cross-references. For example:

**16 SPACE TRANSPORTATION**
Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

## CROSS-REFERENCES

Individual *STAR* abstracts are not ordinarily cross-referenced, except for certain conference reports or book translations that have had separate abstracts written for their component papers or chapters. Citations and abstracts of the components follow immediately after those of the parent document. When the subject content of a component differs sufficiently from the general content of the parent, a cross-reference citation also is printed at the end of the category to which it normally would have been assigned if it were independent.

## DOCUMENTS ON MICROFICHE

Documents available on microfiche are designated by a pound sign (#) following the accession number.

## LIMITED REPRODUCIBILITY

A note of limited reproducibility appears in the citation, if there are factors affecting the reproducibility of more than 20% of the document. These factors include faint or broken type, color photographs, black and white photographs, foldouts, dot matrix print, or some other factor that limits the reproducibility of the document. This notation also appears on the microfiche header with the specific factor checked off on a list visible in the second frame.

## COLOR COPIES

An increasing number of NASA scientific and technical reports are being produced with color graphs, charts, illustrations, and photographs. An indication that a document has color pages follows the source and pricing (SAP) information in the *STAR* citation.

Registered users of the NASA Scientific and Technical Information Program will receive ordered documents with color at no additional cost, as long as stock copies of the document are available. Otherwise, an additional fee of $2.00 per color page will be charged. The NASA Center for AeroSpace Information staff will contact registered users to determine individual user's needs.

## NASA PATENTS AND PATENT APPLICATIONS

Patents and patent applications owned by NASA are announced in *STAR* under appropriate subject categories and are referenced in the *STAR* indexes. In the Report/Accession Number Index, patents are indexed by the NASA Case Number, and the U.S. Patent Class. Patent applications are indexed by the NASA Case Number and the U.S. Patent Application Serial Number.

Printed copies of patents (which are not microfiched) are available for purchase from the U.S. Patent and Trademark Office.

NASA patent application specifications are sold in both paper copy and microfiche by the National Technical Information Service (NTIS). The US-Patent-Appl-SN-number should be used in ordering either paper copy or microfiche from NTIS.

When ordering patents, the U.S. Patent Number should be used, and payment must be remitted in advance, by money order or check payable to the Commissioner of Patents and Trademarks. Prepaid purchase coupons for ordering are also available from the U.S. Patent and Trademark Office.

The patents and patent applications announced in *STAR* are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

National Aeronautics and Space Administration
Associate General Counsel for Intellectual Property
Code GP
Washington, DC 20546

## SOURCES FOR DOCUMENTS

One or more sources from which a document announced in *STAR* is available to the public is given in each citation. The most commonly indicated sources and their acronyms or abbreviations are listed on page A-6. If the publication is available from a source other than those listed, the publisher and address will be displayed on the availability line or in combination with the corporate source line.

Avail: NTIS. Sold by the National Technical Information Service. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code following the letters HC or MF in the *STAR* citation. Current values for the price codes are given in the tables on page A-7.

Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) is available at greatly reduced unit prices. For this service and for information concerning subscription to NASA printed reports, consult the NTIS Subscription Section, Springfield, VA 22161.

NOTE ON ORDERING DOCUMENTS: When ordering NASA publications (those followed by the * symbol), use the N accession number. NASA patent applications (only the specifications are offered) should be ordered by the US-Patent-Appl-SN number. Non-NASA publications (no asterisk) should be ordered by the AD, PB, or other *report number* shown on the last line of the citation, not by the N accession number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The current price and order number are given following the availability line. (NTIS will fill microfiche requests, as indicated above, for those documents identified by a # symbol.)

Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, address inquiry to the BLL.)

Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in *Energy Research Abstracts*. Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center - Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

Avail: ESDU. Pricing information on specific data, computer programs, and details on Engineering Sciences Data Unit (ESDU) topic categories can be obtained from ESDU International Ltd. Requesters in North America should use the Virginia address while all other requesters should use the London address, both of which are on page A-6.

Avail: Fachinformationszentrum, Karlsruhe. Sold by the Fachinformationszentrum Energie, Physik, Mathematik GMBH, Eggenstein Leopoldshafen, Federal Republic of Germany, at the price shown in deutschmarks (DM).

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, CA. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.

Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Documents Room (Room 126), 600 Independence Ave., S.W., Washington, DC 20546, or public document rooms located at NASA installations, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.

Avail: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of $1.50 each, postage free. (See discussion of NASA patents and patent applications below.)

Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INIS) representative in their country, or by applying directly to the issuing organization.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed on page A-6. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

**FEDERAL DEPOSITORY LIBRARIES:** To provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 52 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. (These libraries are not sales outlets.) At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 52 regional depositories. A list of the regional GPO libraries, appears on page A-8. A local library can contact a regional depository library to help locate specific reports, or direct contact may be made by an individual.

## PUBLIC COLLECTION OF NASA DOCUMENTS

An extensive collection of NASA and NASA-sponsored publications is maintianed by the British Library Lending Divison, Boston Spa, Wetherby, Yorkshire, England, for public access. The British Library Lending Division also has available many of the non-NASA publications cited in *STAR*.

European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols # and * from ESA—Information Retrieval Service, European Space Agency, 8-10 rue Mario-Nikis, 75738 Paris CEDEX 15, France.

## SUBMITTING DOCUMENTS

All users of this abstract service are urged to forward reports to be considered for announcement in *STAR*. This will aid NASA in its efforts to provide the fullest possible coverage of all scientific and technical publications that might support aeronautics and space research and development. If you have prepared relevant reports (other than those you will transmit to NASA, DOD, or DOE through the usual contract- or grant-reporting channels), please send them for consideration to the NASA Center for AeroSpace Information, P.O. Box 8757, Baltimore, MD 21240-0757.

Reprints of journal articles, book chapters, and conference papers are also welcome. These will be considered for announcement in *STAR*'s companion journal, *IAA*.

You may specify a particular source to be included in a report announcement if you wish; otherwise the report will be placed on a public sale at the National Technical Information Service. Copyrighted publications will be announced but not distributed or sold.

## PURCHASE OF *STAR*

*STAR* is publicly available on annual subscription from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

*STAR* is available to registered users on annual subscription from the NASA Center for AeroSpace Information, ATTN: Registration Services, P.O. Box 8757, Baltimore, MD 21240-0757.

Microfiche of the abstract sections of *STAR* are available, on annual subscription only, from NTIS as PB91-911300, Attn: Subscriptions, 5285 Port Royal Road, Springfield, VA 22161. Annual subscription rates are $85.00 North America; $170.00 foreign. Abstract sections for previous years retroactive to 1964 are available at the current rates.

## ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
555 West 57th Street, 12th Floor
New York, New York 10019

British Library Lending Division,
Boston Spa, Wetherby, Yorkshire,
England

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, DC 20231

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

European Space Agency-Information Retrieval Service
ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

Engineering Sciences Data Unit International
P.O. Box 1633
Manassas, Virginia 22110

Engineering Sciences Data Unit International, Ltd.
251-259 Regent Street
London, W1R 7AD, England

Fachinformationszentrum Energie, Physik, Mathematik
GMBH
7514 Eggenstein Leopoldshafen
Federal Republic of Germany

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Center for AeroSpace Information
P.O. Box 8757
Baltimore, Maryland 21240-0757

National Aeronautics and Space Administration
Scientific and Technical Information Program (JTT)
Washington, DC 20546

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, California 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Geological Survey Library National Center
MS 950
12201 Sunrise Valley Drive
Reston, Virginia 22092

U.S. Geological Survey Library
2255 North Gemini Drive
Flagstaff, Arizona 86001

U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS914
Denver, Colorado 80225

# NTIS PRICE SCHEDULES

(Effective October 1, 1991)

## Schedule A
## STANDARD PRICE DOCUMENTS AND MICROFICHE**

| PRICE CODE | NORTH AMERICAN PRICE | FOREIGN PRICE |
|---|---|---|
| A01 | $ 9.00 | $ 18.00 |
| A02 | 12.50 | 25.00 |
| A03 | 17.00 | 34.00 |
| A04-A05 | 19.00 | 38.00 |
| A06-A09 | 26.00 | 52.00 |
| A10-A13 | 35.00 | 70.00 |
| A14-A17 | 43.00 | 86.00 |
| A18-A21 | 50.00 | 100.00 |
| A22-A25 | 59.00 | 118.00 |
| A99 | * | * |
| N01 | 60.00 | 120.00 |
| N02 | 59.00 | 118.00 |
| N03 | 20.00 | 40.00 |

## Schedule E
## EXCEPTION PRICE DOCUMENTS AND MICROFICHE**

| PRICE CODE | NORTH AMERICAN PRICE | FOREIGN PRICE |
|---|---|---|
| E01 | $11.00 | $ 22.00 |
| E02 | 14.00 | 28.00 |
| E03 | 16.00 | 32.00 |
| E04 | 19.00 | 38.00 |
| E05 | 21.00 | 42.00 |
| E06 | 24.00 | 48.00 |
| E07 | 27.00 | 54.00 |
| E08 | 30.00 | 60.00 |
| E09 | 33.00 | 66.00 |
| E10 | 36.00 | 72.00 |
| E11 | 39.00 | 78.00 |
| E12 | 43.00 | 86.00 |
| E13 | 46.00 | 92.00 |
| E14 | 50.00 | 100.00 |
| E15 | 54.00 | 108.00 |
| E16 | 59.00 | 118.00 |
| E17 | 64.00 | 128.00 |
| E18 | 69.00 | 138.00 |
| E19 | 76.00 | 152.00 |
| E20 | 88.00 | 176.00 |
| E99 | * | * |

* Contact NTIS for price quote.

** Effective January 1, 1991, the microfiche copy of any new document entering the NTIS collection will be priced the same as the paper copy of the document.

### IMPORTANT NOTICE

NTIS Shipping and Handling Charges

U.S., Canada, Mexico — ADD $3.00 per TOTAL ORDER

All Other Countries — ADD $4.00 per TOTAL ORDER

Exceptions — Does NOT apply to:

ORDERS REQUESTING NTIS RUSH HANDLING
ORDERS FOR SUBSCRIPTION OR STANDING ORDER PRODUCTS *ONLY*

NOTE: Each additional delivery address on an order requires a separate shipping and handling charge.

# FEDERAL REGIONAL DEPOSITORY LIBRARIES

## ALABAMA

**AUBURN UNIV. AT MONTGOMERY LIBRARY**
Documents Dept.
7300 University Drive
Montgomery, AL 36117-3596
(205) 244-3650 FAX: (205) 244-0678

**UNIV. OF ALABAMA**
Amelia Gayle Gorgas Library
Govt. Documents
Box 870266
Tuscaloosa, AL 35487-0266
(205) 348-6046 FAX: (205) 348-8833

## ARIZONA

**DEPT. OF LIBRARY, ARCHIVES, AND PUBLIC RECORDS**
Federal Documents
Third Floor State Capitol
1700 West Washington
Phoenix, AZ 85007
(602) 542-4121 FAX: (602) 542-4400; 542-4500

## ARKANSAS

**ARKANSAS STATE LIBRARY**
State Library Services
One Capitol Mall
Little Rock, AR 72201
(501) 682-2869

## CALIFORNIA

**CALIFORNIA STATE LIBRARY**
Govt. Publications Section
914 Capitol Mall - P.O. Box 942837
Sacramento, CA 94237-0001
(916) 322-4572 FAX: (916) 324-8120

## COLORADO

**UNIV. OF COLORADO - BOULDER**
Norlin Library
Govt. Publications
Campus Box 184
Boulder, CO 80309-0184
(303) 492-8834 FAX: (303) 492-2185

**DENVER PUBLIC LIBRARY**
Govt. Publications Dept. BS/GPD
1357 Broadway
Denver, CO 80203
(303) 571-2135

## CONNECTICUT

**CONNECTICUT STATE LIBRARY**
231 Capitol Avenue
Hartford, CT 06106
(203) 566-4971 FAX: (203) 566-3322

## FLORIDA

**UNIV. OF FLORIDA LIBRARIES**
Documents Dept.
Library West
Gainesville, FL 32611-2048
(904) 392-0366 FAX: (904) 392-7251

## GEORGIA

**UNIV. OF GEORGIA LIBRARIES**
Govt. Documents Dept.
Jackson Street
Athens, GA 30602
(404) 542-8949 FAX: (404) 542-6522

## HAWAII

**UNIV. OF HAWAII**
Hamilton Library
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948-8230 FAX: (808) 956-5968

## IDAHO

**UNIV. OF IDAHO LIBRARY**
Documents Section
Moscow, ID 83843
(208) 885-6344 FAX: (208) 885-6817

## ILLINOIS

**ILLINOIS STATE LIBRARY**
Reference Dept.
300 South Second
Springfield, IL 62701-1796
(217) 782-7596 FAX: (217) 524-0041

## INDIANA

**INDIANA STATE LIBRARY**
Serials/Documents Section
140 North Senate Avenue
Indianapolis, IN 46204
(317) 232-3678 FAX: (317) 232-3728

## IOWA

**UNIV. OF IOWA LIBRARIES**
Govt. Publications Dept.
Washington & Madison Streets
Iowa City, IA 52242
(319) 335-5926 FAX: (319) 335-5830

## KANSAS

**UNIV. OF KANSAS**
Govt. Documents & Map Library
6001 Malatt Hall
Lawrence, KS 66045-2800
(913) 864-4660 FAX: (913) 864-5380

## KENTUCKY

**UNIV. OF KENTUCKY LIBRARIES**
Govt. Publications/Maps Dept.
Lexington, KY 40506-0039
(606) 257-3139 FAX: (606) 257-1563; 257-8379

## LOUISIANA

**LOUISIANA STATE UNIV.**
Middleton Library
Govt. Documents Dept.
Baton Rouge, LA 70803
(504) 388-2570 FAX: (504) 388-6992

**LOUISIANA TECHNICAL UNIV.**
Prescott Memorial Library
Govt. Documents Dept.
305 Wisteria Street
Ruston, LA 71270-9985
(318) 257-4962 FAX: (318) 257-2447

## MAINE

**TRI-STATE DOCUMENTS DEPOSITORY**
Raymond H. Fogler Library
Govt. Documents & Microforms Dept.
Univ. of Maine
Orono, ME 04469
(207) 581-1680

## MARYLAND

**UNIV. OF MARYLAND**
Hornbake Library
Govt. Documents/Maps Unit
College Park, MD 20742
(301) 454-3134 FAX: (301) 454-4985

## MASSACHUSETTS

**BOSTON PUBLIC LIBRARY**
Govt. Documents Dept.
666 Boylston Street
Boston, MA 02117
(617) 536-5400 ext. 226
FAX: (617) 267-8273; 267-8248

## MICHIGAN

**DETROIT PUBLIC LIBRARY**
5201 Woodward Avenue
Detroit, MI 48202-4093
(313) 833-1440; 833-1409
FAX: (313) 833-5039

**LIBRARY OF MICHIGAN**
Govt. Documents Unit
P.O. Box 30007
Lansing, MI 48909
(517) 373-0640 FAX: (517) 373-3381

## MINNESOTA

**UNIV. OF MINNESOTA**
Wilson Library
Govt. Publications Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 624-5073 FAX: (612) 626-9353

## MISSISSIPPI

**UNIV. OF MISSISSIPPI**
J.D. Williams Library
Federal Documents Dept.
106 Old Gym Bldg.
University, MS 38677
(601) 232-5857 FAX: (601) 232-5453

## MISSOURI

**UNIV. OF MISSOURI - COLUMBIA**
Ellis Library
Govt. Documents
Columbia, MO 65201
(314) 882-6733 FAX: (314) 882-8044

## MONTANA

**UNIV. OF MONTANA**
Maureen & Mike Mansfield Library
Documents Div.
Missoula, MT 59812-1195
(406) 243-6700 FAX: (406) 243-2060

## NEBRASKA

**UNIV. OF NEBRASKA - LINCOLN**
D.L. Love Memorial Library
Documents Dept.
Lincoln, NE 68588
(402) 472-2562

## NEVADA

**UNIV. OF NEVADA**
Reno Library
Govt. Publications Dept.
Reno, NV 89557
(702) 784-6579 FAX: (702) 784-1751

## NEW JERSEY

**NEWARK PUBLIC LIBRARY**
U.S. Documents Div.
5 Washington Street - P.O. Box 630
Newark, NJ 07101-0630
(201) 733-7812 FAX: (201) 733-5648

## NEW MEXICO

**UNIV. OF NEW MEXICO**
General Library
Govt. Publications Dept.
Albuquerque, NM 87131-1466
(505) 277-5441 FAX: (505) 277-6019

**NEW MEXICO STATE LIBRARY**
325 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827-3826 FAX: (505) 827-3820

## NEW YORK

**NEW YORK STATE LIBRARY**
Documents/Gift & Exchange Section
Federal Depository Program
Cultural Education Center
Albany, NY 12230
(518) 474-5563 FAX: (518) 474-5786

## NORTH CAROLINA

**UNIV. OF NORTH CAROLINA - CHAPEL HILL**
CB#3912, Davis Library
BA/SS Dept.—Documents
Chapel Hill, NC 27599
(919) 962-1151 FAX: (919) 962-0484

## NORTH DAKOTA

**NORTH DAKOTA STATE UNIV. LIBRARY**
Documents Office
Fargo, ND 58105
(701) 237-8886 FAX: (701) 237-7138
In cooperation with Univ. of North Dakota, Chester Fritz Library
Grand Forks

## OHIO

**STATE LIBRARY OF OHIO**
Documents Dept.
65 South Front Street
Columbus, OH 43266
(614) 644-7051 FAX: (614) 752-9178

## OKLAHOMA

**OKLAHOMA DEPT. OF LIBRARIES**
U.S. Govt. Information Div.
200 NE 18th Street
Oklahoma City, OK 73105-3298
(405) 521-2502, ext. 252, 253
FAX: (405) 525-7804

**OKLAHOMA STATE UNIV.**
Edmon Low Library
Documents Dept.
Stillwater, OK 74078
(405) 744-6546 FAX: (405) 744-5183

## OREGON

**PORTLAND STATE UNIV.**
Millar Library
934 SW Harrison - P.O. Box 1151
Portland, OR 97207
(503) 725-3673 FAX: (503) 725-4527

## PENNSYLVANIA

**STATE LIBRARY OF PENN.**
Govt. Publications Section
Walnut St. & Commonwealth Ave. - P.O. Box 1601
Harrisburg, PA 17105
(717) 787-3752

## SOUTH CAROLINA

**CLEMSON UNIV.**
Cooper Library
Public Documents Unit
Clemson, SC 29634-3001
(803) 656-5174 FAX: (803) 656-3025
In cooperation with Univ. of South Carolina, Thomas Cooper Library, Columbia

## TENNESSEE

**MEMPHIS STATE UNIV. LIBRARIES**
Govt. Documents
Memphis, TN 38152
(901) 678-2586 FAX: (901) 678-2511

## TEXAS

**TEXAS STATE LIBRARY**
United States Documents
P.O. Box 12927 - 1201 Brazos
Austin, TX 78711
(512) 463-5455 FAX: (512) 463-5436

**TEXAS TECH. UNIV. LIBRARY**
Documents Dept.
Lubbock, TX 79409
(806) 742-2268 FAX: (806) 742-1920

## UTAH

**UTAH STATE UNIV.**
Merrill Library & Learning Resources Center, UMC-3000
Documents Dept.
Logan, UT 84322-3000
(801) 750-2684 FAX: (801) 750-2677

## VIRGINIA

**UNIV. OF VIRGINIA**
Alderman Library
Govt. Documents
Charlottesville, VA 22903-2498
(804) 924-3133 FAX: (804) 924-4337

## WASHINGTON

**WASHINGTON STATE LIBRARY**
Document Section
MS AJ-11
Olympia, WA 98504-0111
(206) 753-4027 FAX: (206) 753-3546

## WEST VIRGINIA

**WEST VIRGINIA UNIV. LIBRARY**
Govt. Documents Section
P.O. Box 6069
Morgantown, WV 26506
(304) 293-3640

## WISCONSIN

**ST. HIST. SOC. OF WISCONSIN LIBRARY**
Govt. Publications Section
816 State Street
Madison, WI 53706
(608) 262-2781 FAX: (608) 262-4711
In cooperation with Univ. of Wisconsin-Madison, Memorial Library

**MILWAUKEE PUBLIC LIBRARY**
Documents Div.
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-2167 FAX: (414) 278-2137

## WYOMING

**WYOMING STATE LIBRARY**
Supreme Court & Library Bldg.
Govt. Publications
Cheyenne, WY 82002
(307) 777-5920 FAX: (307) 777-6289

National Aeronautics and
Space Administration
Code JTT
Washington, D.C.
20546
Official Business
Penalty for Private Use, $300

SPECIAL FOURTH-CLASS RATE
POSTAGE & FEES PAID
NASA
PERMIT No. G27

POSTMASTER: If Undeliverable (Section 158
Postal Manual) Do Not Return